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(54) Title: APPARATUS AND METHOD FOR AUTOMATED DISPLAY OF MARKET ACTIVITY

(57) Abstract:

PATENT COOPERATION TREATY

PCT

DECLARATION OF NON-ESTABLISHMENT OF INTERNATIONAL SEARCH REPORT

(PCT Article 17(2)(a), Rules 13ter.1(c) and Rule 39)

Applicant's or agent's file reference **C30346PCT**	IMPORTANT DECLARATION	Date of mailing(day/month/year) **18/04/2002**
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Applicant
TRADESCAPE TECHNOLOGIES, L.L.C.

This International Searching Authority hereby declares, according to Article 17(2)(a), that no international search report will be established on the international application for the reasons indicated below

1. [X] The subject matter of the international application relates to:

   a. [ ] scientific theories.

   b. [ ] mathematical theories

   c. [ ] plant varieties.

   d. [ ] animal varieties.

   e. [ ] essentially biological processes for the production of plants and animals, other than microbiological processes and the products of such processes.

   f. [X] schemes, rules or methods of doing business.

   g. [ ] schemes, rules or methods of performing purely mental acts.

   h. [ ] schemes, rules or methods of playing games.

   i. [ ] methods for treatment of the human body by surgery or therapy.

   j. [ ] methods for treatment of the animal body by surgery or therapy.

   k. [ ] diagnostic methods practised on the human or animal body.

   l. [ ] mere presentations of information.

   m. [ ] computer programs for which this International Searching Authority is not equipped to search prior art.

2. [ ] The failure of the following parts of the international application to comply with prescribed requirements prevents a meaningful search from being carried out:

   [ ] the description   [ ] the claims   [ ] the drawings

3. [ ] The failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions prevents a meaningful search from being carried out:

   [ ] the written form has not been furnished or does not comply with the standard.

   [ ] the computer readable form has not been furnished or does not comply with the standard.

4. Further comments:

Name and mailing address of the International Searching Authority	Authorized officer
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FURTHER INFORMATION CONTINUED FROM   PCT/ISA/ 203

The claims relate to subject matter for which no search is required
according to Rule 39 PCT. Given that the claims are formulated in terms
of such subject matter or merely specify commonplace features relating to
its technological implementation, the search examiner could not establish
any technical problem which might potentially have required an inventive
step to overcome. Hence it was not possible to carry out a meaningful
search into the state of the art (Art. 17(2)(a)(i) and (ii) PCT; see
Guidelines Part B Chapter VIII, 1-6).

The applicant's attention is drawn to the fact that claims relating to
inventions in respect of which no international search report has been
established need not be the subject of an international preliminary
examination (Rule 66.1(e) PCT). The applicant is advised that the EPO
policy when acting as an International Preliminary Examining Authority is
normally not to carry out a preliminary examination on matter which has
not been searched. This is the case irrespective of whether or not the
claims are amended following receipt of the search report or during any
Chapter II procedure. If the application proceeds into the regional phase
before the EPO, the applicant is reminded that a search may be carried
out during examination before the EPO (see EPO Guideline C-VI, 8.5),
should the problems which led to the Article 17(2) declaration be
overcome.

Thus there is a need for advanced apparatus and methods for displaying information indicating in more useful ways market motions represented by time-dependent measures. The present invention provides such apparatus and methods. The present invention is described primarily in terms of displays of market information, but

5   persons skilled in the art will recognize that the invention in many embodiments will be used to implement displays for other types of time-dependent information.

SUMMARY

In a first aspect of the invention, a display is provided depicting market activity,

10   the display comprising a display area disposed on a display screen, information indicative of market activity displayed in the display area, the information being dependent upon market data and tick times. In this aspect of the invention, the display area is typically divided into at least one display cell. In some embodiments of this aspect, the information indicative of market activity comprises color values dependent upon market

15   data and upon tick times, the color values being displayed as colors in the display area.

In other embodiments, the information indicative of market activity comprises a list of top moving securities comprising a predetermined number of securities, and further comprising a security occupying a bottom position in the list ("the bottom listed security"). In such embodiments, the display comprises automated computing machinery

20   that computes, for each security identified by a symbol in data representing a tick ("the tick security"), a security momentum. The automated computing machinery in such embodiments also computes a comparison of the security momentum of the tick security and the security momentum of the bottom listed security, replacement of the bottom listed security with the tick security if the security momentum of the tick security is

25   greater than the security momentum of the bottom listed security, thereby including the tick security in the list. The automated computing machinery also computes, if the tick security is included in the list, a comparison of the security momentum of the tick security and the security momentum of a security just above the tick security in the list, and an exchange of the positions of the tick security and the security just above the tick

30   security in the list if the security momentum of the tick security is greater than the security momentum of the security just above the tick security in the list.

In embodiments implementing lists of top moving securities, when computing a security momentum, the automated computing machinery also computes a time difference between a current time and stored tick times and a sum of the time differences so computed.

5   In a further aspect of the invention, a method is provided for representing market activity, wherein market data dependent upon market activity is received in a data stream through a communications port. The method comprises the steps of storing data representing a tick and creating a display dependent upon the data representing a tick. The method, in further embodiments, when data representing a tick is received, includes

10   also storing the data representing a tick, this step further comprising storing the time the data representing the tick was received ("tick time") in a time array having a number of ordered elements including a first element and a last element.

        In such embodiments, the method includes shifting the contents of the time array toward the last element, thereby emptying the first element and overwriting the last

15   element; and storing the tick time in the first element. The method in further embodiments includes creating a display comprising calculating a color value for each tick time stored in the time array, the color values being dependent upon the corresponding tick times. In such embodiments, the method includes periodically displaying colors corresponding to the color values.

20   In such embodiments, the method includes creating a display by retrieving from computer memory the tick time stored in each element of the time array, transforming each tick time in the time array into a color value, and displaying each color value onto a computer screen.

        In a still further aspect of the invention, there is provided a method creating a

25   display comprising generating a list of top moving securities dependent upon data representing a tick, the list comprising at least one listed security and a bottom listed security. In this aspect of the invention, data representing a tick is received and generating a list further comprises calculating from the stored tick times a security momentum for the security identified by the symbol in the data representing the tick ("the

30   tick security"), said security momentum being a numeric indication of relative security price motion; and generating a list of securities having the highest security momenta. In

many embodiments of this aspect of the invention, calculating from the stored tick times a security momentum includes calculating time differences between a current time and stored tick times and summing the calculated time differences.

In further embodiments of this aspect of the invention, generating a list of
5   securities with the highest security momentums calculating the security momentum for the security just above the tick security on the list; and comparing the security momentum of the security just above the tick security and the security momentum of the tick security. In such embodiments, generating a list further includes, when the comparison shows that the security momentum of the tick security is greater than the
10   security momentum of the security just above the tick security on the list, swapping the positions of the tick security and the security just above the tick security on the list.

Such embodiments also repeat the steps of calculating the security momentum for the security just above the tick security on the list, comparing the security momentum of the security just above the tick security and the security momentum of the tick security,
15   and, when the comparison shows that the security momentum of the tick security is greater than the security momentum of the security just above the tick security on the list, swapping the positions of the tick security and the security just above the tick security on the list.

In a further aspect of the invention, a system for representing market activity is
20   implemented in software on a digital computer, wherein the market activity is represented by a data stream, received through a communications port, and the system comprises means for storing data representing a tick; and means for creating a display dependent upon the data representing a tick.

In some embodiments of this aspect of the invention, means for creating a display
25   further comprises means for generating a list of top moving securities dependent upon the data representing a tick, the list comprising at least one listed security and a bottom listed security. In such embodiments, when data representing a tick is received, means for generating a list further comprises, means for calculating from stored tick times a security momentum for the security identified by the symbol in the data representing the tick ("the
30   tick security"), said security momentum being a numeric indication of relative security

price motion, and means for generating a list of securities having the highest security momenta.

Further embodiments of this aspect of the invention provide means for calculating from the stored tick times a security momentum, including means for calculating time differences between a current time and stored tick times; and means for summing the calculated time differences.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a diagram of an implementation of the invention.

Figure 2 illustrates the data structure of a NASDAQ Level II Quote.

Figure 2A shows an example data structure for data representing ticks.

Figure 3 shows an example array structure for storing tick times.

Figure 3A is an example illustration of steps involved in calculating a color value.

Figure 4 is an example illustration of the steps involved in transforming a tick time into a color value.

Figure 5 is an example of pseudo-code for transforming tick times into color values.

Figure 6 is an illustration of a thermograph displayed on a computer screen.

Figure 6A diagrams the relationship between a time array and a display area of a thermograph on the computer screen.

Figure 6B is an example diagram of steps involved in calculating time differences.

Figure 7A is an example of thermographs displaying up ticks and down ticks on both sides.

Figure 7B is an example of thermographs displaying up ticks on both sides.

Figure 7C is an example of thermographs displaying down ticks on both sides.

Figure 7D is an example of a thermograph displaying up ticks on the bid side.

Figure 7E is an example of a thermograph displaying down ticks on the bid side.

Figure 7F is an example of a thermograph displaying up ticks on the ask side.

Figure 7G is an example of a thermograph displaying down ticks on the ask side.

Figure 8 is a diagram of steps in displaying the list of top moving securities.

Figure 9A is a diagram of steps involved in calculating a security momentum.

Figure 9B is example pseudo-code for calculating a security momentum.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Definitions:

"ECN" abbreviates "Electronic Communications Network," referring to an order matching service that provides liquidity only by matching orders rather than by maintaining inventory. In the context of the invention, ECNs are considered markets. In order to avoid confusion with data communications networks, ECNs are referred to as either "ECNs" or as "markets." All ECNs have their own data communications protocols which must be followed by all systems submitting orders to ECNs. The ECNs data communications protocols are public and well-known. Current ECNs, their symbols and names, are listed below. Obviously the number of ECNs can change at any time.

Example List of ECNs

MMID	Name
ARCA	Archipelago
ATTN	Attain
BRUT	Brass Securities
BTRD	Bloomberg Trade Book
INCA	Instinet
ISLD	Island
MWSE	Midwest Stock Exchange
NTRD	NexTrade
REDI	Speer Leeds
STRK	Strike
TNTO	Terranova

"Market," "electronic market," "market participant," "electronic market participant," "marketing network," and electronic marketing network" are all used as
5   synonyms for services accessible through electronic communications networks capable of executing orders for securities by accepting from broker/dealers buy orders and sell orders, matching or failing to match buy orders with sell orders, and communicating the results to the broker/dealers. Generally, the term "market" is used to refer to these entities. All "markets," as the term is used, are either ECNs or market makers. All
10   available markets have names and symbols as described under the definitions of "ECN" and "market maker."

      "Market maker" means a broker/dealer providing order matching and liquidity in a stock by maintaining an inventory of the stock traded through a national market. Currently active market makers, their symbols and names, are listed below. Obviously,
15   the number and identity of market makers can change at any time.

<u>Example List of Market Makers</u>

<u>MMID</u>	<u>Name</u>
BEST	Bear, Stearns & Co., Inc.
BTAB	Alex, Brown & Sons, Inc.
GSCO	Goldman, Sachs & Co.
HMQT	Hambrecht & Quist, LLC
HRZG	Herzog, Heine, Geduld, Inc.
JANY	Janney Montgomery Scott, Inc.
LEHM	Lehman Brothers, Inc.
MADF	Bernard L. Madoff
MLCO	Merrill Lynch, Pierce, Fenner & Smith Inc.
MOKE	Morgan, Keehan& Co., Inc.
MONT	Nationsbanc Montgomery Securities, LLC
MSCO	Morgan Stanley & Co., Inc.
NITE	Knight Securities, L.P..
OLDE	Olde Discount Corporation
OPCO	CIBC Oppenheimer Corporation
PIPR	Piper Jaffray Inc.
PRUS	Prudential Securities, Inc.
PWJC	Paine Webber, Inc.
RAJA	Raymond James & Associates, Inc.
SBSH	Smith Barney, Inc.
SHRP	Sharpe Capital, Inc.
SHWD	Sherwood Securities Corporation

"MMID" abbreviates Market Maker ID, a code identifying a market maker. All NASDAQ traders, including ECNs, are assigned MMIDs.

5   "NASDAQ Level II Quotes" are provided in a stream of data directly from NASDAQ. NASDAQ Level II Quotes includes market information for markets offering to buy or sell stocks. The market information provided in a Level II Quote includes price, side, quantity, and market identification for each market offering to buy or sell a stock listed on NASDAQ.

10

"National market" means NASDAQ, the New York Stock Exchange, and the American Stock Exchange. SOES and SelectNet are national-level stock trading services provided through NASDAQ.

"Quotes" are aggregates of information regarding securities traded in markets.
5   Quotes include securities listed for sale or purchase, symbols identifying the securities, price, side, quantities, and market identifications or MMIDs. Quotes can come from NASDAQ or directly from markets. A "NASDAQ Level II Quote" includes market information for all markets offering to buy or sell a particular security. Obtaining quotes directly from markets is typically faster than obtaining them from NASDAQ.

10   "Securities" are any agreement for investment. Stocks are the securities most often addressed in described embodiments of the invention. The invention, however, is applicable to many kinds of securities including, for example, options, commodities, and bonds.

"SelectNet" is a NASDAQ system for indirect submission to market makers and
15   to ECNs of electronic orders for stocks listed on NASDAQ. SelectNet implements orders which are broadcasted to many markets or directed to particular selected markets. SelectNet orders for selected markets require MMIDs as parameters, the MMIDs being derived from quotes for the stock in the order. The operations of SelectNet are well-known.

20   "Side" refers to which side of the market is represented by an order or a quote. Side indicates whether the quote or order is to buy or sell, bid or ask. "Bid" indicates the buy side. "Ask" indicates the sell side. The present invention functions equally for either side of a transaction. Therefore, side is described generally in neutral terms.

"STL" abbreviates "standard template library," referring to the ANSI/ISO
25   Standard Template Library. "STL" is used generally to refer to standard container templates.

"Symbol" refers to the trading symbol for a stock or other security.

A "ticks" is a change in a quoted price for a security. Data representing ticks is received in market data, typically in the form of streaming NASDAQ quotes, electronic
30   market information from ECNs or market makers, or other sources.

"Tick time" refers to the time when data representing a tick is received.

Detailed Description

In Figure 1, there is illustrated an overview of processing steps for one embodiment of the present invention. The method of the illustrated embodiment comprises the steps of receiving (106) through a communications port (104), a data stream (102) of NASDAQ Level II quotes (108) that represent market activity, storing (114) from the NASDAQ Level II Quotes (108) data representing ticks (112), and creating (116) displays (119) based upon the data representing ticks (112). Displays (119) include thermographs and Lists of Top Movers as described below.

In some embodiments, the data stream (102) comprises NASDAQ Level II Quotes (108). The structure of NASDAQ Level II Quotes (108) is illustrated at Figure 2. The data elements in NASDAQ Level II Quotes (108) include the following elements which are used as indicated:

Field	Description
Symbol (202)	the symbol for the stock or other security whose market information comprises the quote.
LastTradePrice (204)	the price of the stock in its last trade.
ClosePrice (206)	the price of the stock in its last trade before closing in the previous trading day.
NetChange (208)	the difference between LastTradePrice (1304) and ClosePrice (1306).
NationalMarket (209)	the national market of the stock's last trade.
Typical Quantity (210)	the usual quantity in which the stock trades.
TickDirection (212)	whether the current LastTradePrice (1304) is higher or lower than the LastTradePrice of the quote for the stock's most recent previous trade.
High (214)	the stock's highest price in the current session.
Low (216)	the stock's lowest price in the current trading session.
Side (218)	whether a displayed offer is a bid or ask.
Quantity (220)	the number of shares represented in a displayed offer.
MMID (222)	The market symbol for the ECN or market maker displaying an offer.
Price (224)	The share price in a displayed offer.

In this embodiment of the present invention, a NASDAQ Level II Quote (108) is received every time a market maker makes a change in a quoted price for a security. Ticks are changes in quoted prices for securities. Data representing ticks (112) are

derived in some embodiments from NASDAQ Level II Quotes (108). In other embodiments, data representing ticks (112) is derived from market information received directly from ECNs, market makers, other broker/dealers, or other sources.

The data representing ticks (112) is derived from data elements in the NASDAQ

5   Level II Quotes (108). The data elements used to derive the data representing ticks (112) are symbols (202), tick direction (212), and side (218). Symbols (202) are securities symbols identifying the security for which the tick represents a price change. Tick direction (212) is an indication whether the price change identified by the tick was an increase or decrease in a quoted price. Ticks showing price increases are referred to as

10   "up ticks." Ticks showing price decreases are referred to as "down ticks."

Side (218) is an indication whether the price in the tick quote is a bid price or an ask price. Bid quotes are indications of the markets' willingness to buy securities at a bid price. Ask quotes are indications of the markets' willingness to sell securities at an ask price.

15   The step (114) of storing data representing ticks (112), illustrated in Figure 1, further includes determining the time a quote (108) is received from NASDAQ ("tick time"). For example, in some embodiments of the present invention, the tick time is determined by reading the system clock from the computer. After the tick time is derived, it is stored (114) in data representing ticks (112).

20   According to the embodiment illustrated in Figure 1, every time a NASDAQ Level II quote (108) is received (106), a tick time is stored (114) in data representing ticks (112). Figure 2A illustrates one embodiment of the data structure used to store the data representing ticks (112). The tick time is stored in either up ticks (290) or down ticks (292) based upon the side (218) and tick direction (212) indications received in the

25   NASDAQ quote (108). In this specific embodiment, both up ticks (290) and down ticks (292) are implemented as arrays (306) for storing tick times.

Referring to Figure 3, there is illustrated an embodiment of a time array (306) utilized to store tick times. In some embodiments of the present invention, when a tick is received, the tick time is always initially stored in the first element (302) of the time

30   array (306). In order to store a tick time in the first element (302) of the time array (306), the contents of the time array (306) are shifted toward the last element (304) of the time

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array (306), thereby emptying the first element (302) and overwriting the last element (304) of time array (306).

In further embodiments of the invention, displays are implemented as thermographs. Figure 3A illustrates creation of the type of display called a thermograph
5   (120). The creation of thermograph (120) includes calculating (310) a color value (312) for each tick time (308) stored in each element of time array (306) and displaying (314) periodically each color value (312) on the computer screen (316). In some embodiments, each color value (312) is displayed once per second. Many alternative display rates are within the scope of the invention.

10 Referring to Figure 4, according to a more specific embodiment, the step of calculating a color value further includes the steps of retrieving (406) from the physical computer memory (402) each tick time (404) stored in the first element (302) through the last element (304) in time array (306) and transforming (408) each retrieved tick time (404) from the time array (306) into a color value (410). In one embodiment of the
15 invention, the step of transforming (408) tick times (404) into color values (410) operates generally as illustrated in the pseudo-code shown in Figure 5.

According to the embodiment illustrated in Figure 6, the creation of thermograph (120) further includes locating a display area (608) on video screen (602) and dividing the display area (608) into a number of cells (604). Referring to Figure 6A, "m" in C[m]
20 identifies the number of cells in the display area, and "n" in A[n] identifies the number of elements in time array (306). In some embodiments, as shown in Figure 6A, the array size (620) of time array (306) is the same as the number (622) of cells (604) in the display area (608). Many such embodiments will display in cells (604) the color values derived from the tick times stored in the corresponding elements of time array (306). For
25 example, as shown in Figure 6A, the color value derived from the tick time stored in time array (306) element A[3] (624) is displayed in display area (608) cell C[3](626).

In some embodiments of the present invention, as shown in Figure 6B, a time difference (636) is calculated between the current time (630) and the tick time (404) stored in each element of time array (306). Each calculated (634) time difference (636) is
30 transformed (408) into a color value (410) and then displayed (412) in a cell (604) located in display area (608).

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Referring again to the embodiment illustrated in Figure 6, the color values displayed in cells (604) are utilized to implement the thermograph (120). Thermograph (120) is a set of contiguous cells (604) displaying color values in display area (608) on video screen (602). Because thermograph (120) uses adjacent cells (604) to display color

5   values corresponding to the tick times stored in time array (306), thermograph (120) visually provides a colored bar in which the range of colors displayed corresponds to the activity represented by the tick times. In this embodiment, the range of colors have a beginning color and an ending color. In the specific embodiment illustrated in Figure 6, for example, the range of colors is from beginning color green (617) to ending color

10   black (619).

In the specific embodiment illustrated in Figure 6B, thermograph (120) has a beginning color, green (617) and an ending color, black (619). In this embodiment, when an up tick is received, the calculated (634) time difference (636) between the tick time (404) and the current time (630) is small. Thus, the transformed (408) color value (410)

15   corresponding to the tick time (632) is near the beginning color, green (617). Because the time difference (636) increases over time, if no additional up ticks are received over a period of time, the color displayed for the received up tick fades to black. However, if up ticks are received frequently over a period of time, the corresponding color values (410) transformed (408) for the tick times stored (404) in the time array (306) remain near

20   green. In this embodiment, the colored bar displayed for thermograph (120), for a steady tick stream, remains near green.

Various embodiments of thermographs are used to visually track the market activity of securities. In describing such embodiments, the phrase "green thermograph" refers to a thermograph having beginning color green and ending color black, and "red

25   thermograph" refers to a thermograph having beginning color red and ending color black.

For example, referring to Figure 7A, embodiments of green thermographs (710, 714) are seen displayed on the bid and ask side of the quote and embodiments of red thermographs (708, 712) are seen displayed on the bid and ask side of the quote. In the embodiment illustrated in Figure 7A, the color green represent up ticks and the color red

30   represent down ticks. In this specific embodiment, the illustrated thermographs track up

ticks and down ticks for the bid and the ask side of the quote for the security identified by the symbol MSFT (702).

Referring to Figure 7B, an embodiment of a green thermograph (710) is seen displayed on the bid side (704) of the quote and an embodiment of a green thermograph
5   (714) is seen displayed on the ask side of the quote. In this specific embodiment, the illustrated thermographs track up ticks for the bid side (704) and the ask side (706) of the quote for the security identified by the symbol MSFT (702).

Referring to Figure 7C, an embodiment of a red thermograph (708) is seen displayed on the bid side (704) of the quote and an embodiment of a red thermograph
10 (712) is seen displayed on the ask side of the quote. In this specific embodiment, the illustrated thermographs track down ticks for the bid side (704) and the ask side (706) of the quote for the security identified by the symbol MSFT (702).

Referring to Figure 7D, an embodiment of a green thermograph (710) is seen displayed on the bid side (704) of the quote. In this specific embodiment, the illustrated
15 thermograph tracks the up ticks for the bid side (704) of the quote for the security identified by the symbol MSFT (702).

Referring to Figure 7E, an embodiment of a red thermograph (708) is seen displayed on the bid side (704) of the quote. In this specific embodiment, the illustrated thermograph tracks the down ticks for the bid side (704) of the quote for the security
20 identified by the symbol MSFT (702).

Referring to Figure 7F, an embodiment of a green thermograph (714) is seen displayed on the ask side (706) of the quote. In this specific embodiment, the illustrated thermograph tracks up ticks for the ask side (706) of the quote for the security identified by the symbol MSFT (702).

25 Referring to Figure 7G, an embodiment of a red thermograph (712) is seen displayed on the ask side (706) of the quote. In this specific embodiment, the illustrated thermograph tracks down ticks for the ask side (706) of the quote for the security identified by the symbol MSFT (702).

In another aspect of the present invention as shown in Figure 8, a list (118) of top
30 moving securities is generated (816) from stored tick times (806). As described above, NASDAQ Level II quotes (108) are received (106), the tick times for the received quotes

(108) are derived and then, the tick times are stored (114) in an embodiment of data representing ticks (802). One embodiment of the data representing ticks (802) is shown in Figure 9B. In the embodiment of Figure 9B, in the structure labeled "Movement" (803), tick times (806) are stored for the security represented by the symbol (804).

As shown in Figure 8, the generation (816) of the list (118) of top moving securities is based upon the security momentum (814) of each security in the list. The security momentum (814), which is a numeric indication of relative security price motion, is calculated (810) from the stored tick times (806) in the data representing ticks (802). In some embodiments as illustrated in Figure 9A, the security momentum (814) is calculated by first calculating (934) the time difference (936) between the current time (930) and each tick time (806) stored in the time array (306) and then, summing (938) the calculated time differences (936). In the illustrated embodiment, the step of calculating the security momentum generally functions as illustrated in the pseudo-code shown in Figure 9B.

A further embodiment is shown in Figures 9C and Figure 9D. Referring first to Figure 9C, a NASDAQ Level II Quote (108) is received (106) and a security momentum (814) is calculated (810) for the security identified in the quote (108) ("tick security") (812). A security momentum (956) is calculated (954) for the bottom listed security (940). The security momentum (814) of the tick security (812) is compared (940) with the security momentum (814) of the bottom listed security (952). If the security momentum (814) of tick security (812) is greater than the security momentum (814) of the bottom listed security (952), the bottom listed security (952) is replaced (944) with the tick security (812).

Referring still to Figure 9D, if the tick security (812) is placed on the bottom of the list (118), a security momentum (950) for the security (946) just above the tick security on the list is calculated (948). The security momentum (950) of the security (946) just above the tick security and the security momentum (814) of the tick security (812) is compared (960). If the comparison (960) shows that the security momentum (814) of the tick security (812) is greater than the security momentum (950) of the security (946) just above the tick security on the list, the positions of the tick security (812) and the security (946) just above the tick security on the list are swapped (964).

The steps of calculating (948) the security momentum (950) for the security (946) just
above the tick security on the list, comparing (960) the security momentum (950) of the
security (946) just above the tick security and the security momentum (814) of the tick
security (812), and swapping (964) the positions of the tick security (812) and the
security (946) just above the tick security on the list are repeated (970) until the security
momentum (814) of the tick security (812) is not greater than (972) the security
momentum (950) of the security (946) just above the tick security on the list. The
pseudo-code illustrated in Figure 9E shows in more detail the steps for generating the list
of securities (118) with the highest security momenta.

Examples of alternative structures for the list of securities (118), all within the
scope of the invention, include: arrays of pointers to data representing ticks class objects,
STL string containers, array of pointers to character strings, linked lists of structures
further comprising pointers to character strings, linked lists of structures further
comprising STL string containers, and linked lists of structures further comprising
pointers to character strings.

Referring to Figure 10, alternative embodiments for displaying the list (118) of
securities are illustrated as: text illustrating symbols that identify each security on the list
(1002), thermographs for each security on the list (1004), text symbols with
thermographs located adjacent to the text symbols (1006), a bar chart (1008), and a point
graph (1010).

Referring now to Figure 11, according to a further aspect of the invention, a
system for representing market activity is seen implemented in software operating on a
digital computer (1102). In some embodiments of the present invention, for example,
digital computer (1102) is a personal computer, a workstation, a lap top, or any such type
of processing system. In other embodiments, digital computer (1102) is automated
computing machinery comprising programmable logic arrays. In other embodiments,
digital computer (1102) is automated computing machinery comprising hard-wired logic.

In other embodiments, digital computer (1102) is automated computing machinery
comprising software programs stored in random access memory. In other embodiments,
digital computer (1102) is automated computing machinery comprising software
programs stored in read only memory. In other embodiments, digital computer (1102) is

automated computing machinery comprising software programs stored in programmable read only memory.

The market activity in the system of Figure 11 is represented by data in a data stream (1104), received through a communications port (1106), the system comprising a
5   means (1110) for storing data (1108) representing a tick and a means (1112) for creating displays (1118) dependent upon the data representing a tick. The displays (1118) include thermographs and lists of top movers. Figure 7A through 7G illustrates specific embodiments of thermographs, and Figure 10 illustrates specific embodiments of the lists of top movers, the alternative display forms including text illustrating symbols that
10   identify each security on the list (1002), thermographs for each security on the list (1004), text symbols with thermographs located adjacent to the text symbols (1006), a bar chart (1008), and a point graph (1010).

In some embodiments of the present invention, for example, the connection to the communication port (1106) is a modem connection over a telephone line. In other
15   embodiments, the communication port connection is via local area network, wide area network, dedicated line, satellite or some other type of connection. In the illustrated embodiment, communication port (1106) provides the means for data transmission to the system of Figure 11.

In some embodiments of the present invention, for example, the means for
20   creating (1112) a display is a computer monitor. In other embodiments, means for creating display is a video screen or a computer screen.

According to another embodiment of the invention, the system of Figure 11 further comprises means (1114) for receiving the data stream (1104). In some embodiments, the data stream (1104) comprises NASDAQ Level II Quotes. According
25   to an even more specific embodiment, ticks are represented by data (1108) in the NASDAQ Level II Quotes. In this embodiment, a tick is a change in a quoted price for a security. In such embodiments, means for receiving the data stream is typically a direct subscriber data link to NASDAQ.

According to a more specific embodiment of the invention, the system seen in
30   Figure 11, further comprises means (1120) for determining the time the tick is received from NASDAQ ("tick time"). In some embodiments, a system clock (1120) on a

computer or automated computing machinery is the means for determining the tick time (1122).

Referring now to Figure 12, a specific embodiment is seen in which data (1108) representing ticks comprises a security symbol (1202). According to a more specific embodiment, the data representing ticks further comprises a tick direction (1206) and a side (1208).

According to an even more specific embodiment, the side (1208) of a quote is either a bid (1210) or an ask (1212). A bid (1210) quote is an indication of a market's willingness to buy securities at a price and an ask (1212) quote is an indication of a market's willingness to sell securities at a price. According to an even more specific embodiment, the tick direction (1206) is either up or down. The up tick (1208) indicates an increase in a quoted price and the down tick (1210) indicates a decrease in a quoted price.

Now referring to Figure 13, a specific embodiment is seen in which said means (1110) for storing data (1108) representing a tick further comprises a means (1307) for storing the time the data (1108) representing the tick was received ("tick time") (1122) in a time array (1306) having a number of physical computer memory locations including a first memory location (1306) and a last memory location (1308). In this embodiment, said means (1110) for storing is computer memory, for example, random access memory or read only memory.

Referring to Figure 13A, according to a more specific embodiment, storing data (1108) representing a tick further comprises a means (1320) for shifting the contents of the time array (1304) toward the last memory location (1308), thereby emptying the first memory location (1306) and overwriting the last memory location (1308) and a means (1322) for storing the tick time (1122) in the first memory location (1305). Means for shifting in such embodiments typically comprises a CPU operating under program control to shift the contents of elements of a memory array. Means for storing the tick time in memory typically comprises identified memory storage locations implemented as arrays, linked lists, STL containers, and the like.

Referring to Figure 14, according to a more specific embodiment of the invention, said means for creating (1110) a display further comprises means for calculating (1402) a

20

color value (1404) for each tick time (1122) stored in the time array (1304), the color

values (1404) being dependent upon the corresponding tick times (1122). According to

an even more specific embodiment, said means for calculating (1402) a color value

(1404) further comprises means for retrieving (1406) from computer memory the tick

5   time (1122) stored in each memory location of the time array (1304), means (1408) for

transforming each tick time (1122) in the time array (1304) into a color value (1404) and

means (1410) for displaying each color value (1404) onto a computer screen (1110).

According to an even more specific embodiment, said means (1410) for creating a

display periodically displays the colors corresponding to the color values (1404).

10   Means for calculating (1402) a color value (1404) for each tick time (1122) stored

in the time array (1304), the color values (1404) being dependent upon the corresponding

tick times (1122), comprises, in some embodiments, CPUs operating under software

program control, the software programs being resident in random access memory or read

only memory. Means for calculating (1402) a color value (1404), means for retrieving

15   (1406) from computer memory the tick time (1122) stored in each memory location of

the time array (1304), means (1408) for transforming each tick time (1122) in the time

array (1304) into a color value (1404), and means (1410) for displaying each color value

(1404) onto a computer screen (1110), also each typically comprise, in most

embodiments, CPUs operating under software program control, the software programs

20   being resident in random access memory or read only memory. Similarly, means (1410)

for creating a display for colors corresponding to color values (1404) also typically

comprises, in many embodiments, CPUs operating under software program control, the

software programs being resident in random access memory or read only memory. In

other embodiments, the CPUs operating under program control are replaced with

25   programmable logic arrays or dedicated logic implemented in integrated circuits.

Referring to Figure 15, according to a more specific embodiment, said means

(1408) for transforming each tick time (1122) in the time array (1304) further comprises

a means (1502) for calculating a time difference (1510) between a current time (1506)

and the tick time (1122) stored in each memory location of the time array (1304) and a

30   means (1504) for transforming the time difference (1510) into a color value (1404).

According to an even more specific embodiment, said means (1504) for transforming the

time differences (1510) into color values (1404) operates according to the following formula:

color value = ((Y2-Y1)/(X2-X1))*(x-X1) + Y1, wherein

color value is the color value for display,

x is a time difference between the current time and the tick time stored in a memory location of the time array, the time difference lying within a range of time differences, the range of time differences having a first value in the range of time differences and a last value in the range of time differences,

X1 is the first value in the range of time differences,

X2 is the last value in the range of time differences,

Y1 is the first value in a range of colors, the range of colors having a first value in the range of colors and a last value in the range of colors, and

Y2 is the last value in the range of colors.

Referring to Figure 15, means (1408) for transforming each tick time (1122) in the time array (1304), means (1502) for calculating a time difference (1510) between a current time (1506) and the tick time (1122) stored in each memory location of the time array (1304), and means (1504) for transforming the time difference (1510) into a color value (1404), each typically comprise, in many embodiments, CPUs operating under software program control, the software programs being resident in random access memory or read only memory. In other embodiments, the CPUs operating under program control are replaced with programmable logic arrays or dedicated logic implemented in integrated circuits.

Referring now to Figure 16, a specific embodiment is seen in which a display area (1604) is divided into a number of cells (1606) dependent upon the number of memory locations in the time array (1304). In the illustrated embodiment, "n" is the size of time array (1304) and "m" is the number of cells in display area (1604). The number of cells "m" in display area (1604) corresponds to "n" the size of time array (1304).

Referring still to Figure 16, according to a more specific embodiment, said means (1112) for creating a display further comprises a means (1610) for locating a display area (1604) on a video screen (1112), a means (1612) for dividing the display area (1604) into at least one cell (1606), and a means (1614) for displaying in the cells (1606) on the

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video screen (1112) colors corresponding to the color values (1404).

Referring now to Figure 17, another embodiment of system of the present invention is illustrated. In this embodiment of the system, the means (1112) for creating a display further comprises means (1702) for generating a list (1704) of top moving

5   securities dependent upon the data (1704) representing a tick. The list (1704) of top moving securities further comprises at least one listed security and a bottom listed security (1706).

Referring to Figure 17A, a specific embodiment for data (1704) representing ticks is shown. The data elements in this specific embodiment include a symbol (1740) for

10   identifying the security for which a tick is received and a time array (1306) for storing tick times for the security identified by symbol (1740).

According to a more specific embodiment of the system shown in Figure 17, the means (1702) for generating a list of securities further comprises a means for calculating (1720) from the stored tick times (1122) a security momentum (1715) for the security

15   identified by the symbol in the data (1704) representing the tick ("the tick security"). Security momentum (1715) is a numeric indication of relative security price motion. Means (1702) for generating a list of securities and means for calculating (1720) a security momentum comprise, in the illustrated embodiment, one or more CPUs operating under software program control, the software programs being resident in

20   random access memory or read only memory. In other embodiments, the CPUs operating under program control are replaced with programmable logic arrays or dedicated logic implemented in integrated circuits. The means for calculating the security momentum, in the illustrated embodiment, is programmed to operate generally in accordance with the pseudo-code shown in Figure 9B.

25   According to an even more specific embodiment, the system in Figure 17 further includes a means (1734) for generating a list (1730) of securities having the highest security momenta and a means (1732) for displaying on a computer screen (1112) the list (1704) of securities with the highest security momenta. The means (1734) for generating a list (1730) of securities having the highest security momenta and the means (1732) for

30   displaying on a computer screen (1112) the list (1704) of securities with the highest security momenta comprise, in the illustrated embodiment, one or more CPUs operating

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under software program control, the software programs being resident in random access memory or read only memory. In other embodiments, the CPUs operating under program control are replaced with programmable logic arrays or dedicated logic implemented in integrated circuits. The means (1734) for generating a list of securities

5   with the highest security momenta, in the illustrated embodiment, is programmed to operate generally in accordance with the pseudo-code illustrated in Figure 9E. Illustrated in Figure 10 are alternative embodiments for the displays of the list (1704) of securities with the highest security momenta, the alternatives including text illustrating symbols that identify each security on the list (1002), thermographs for each security on the list

10   (1004), text symbols with thermographs located adjacent to the text symbols (1006), a bar chart (1008), and a point graph (1010).

CLAIMS

What is claimed is:

1.   A display depicting market activity, the display comprising:

a display area disposed on a computer screen;

displayed in the display area, information indicative of market activity,
the information being dependent upon market data and tick
times, wherein the information indicative of market activity
comprises colors dependent upon color values; and

automated computing machinery that computes the color values
according to the formula:

color value = $((Y2-Y1)/(X2-X1))*(x-X1) + Y1$, wherein
color value is the color value for display,

x is a time difference between a current time and the tick time,
the time difference lying within a range of time
differences, the range of time differences having a first
value in the range of time differences and a last value in
the range of time differences,

X1 is the first value in the range of time differences,

X2 is the last value in the range of time differences,

Y1 is a first value in a range of colors, the range of colors
having first value in the range of colors and a last value
in the range of colors, and

Y2 is the last value in the range of colors.

2.   The display of claim 1 wherein the market data is dependent upon market
activity, the market data being received in a computer as a data stream through
a communications port.

3.   The method of claim 1 wherein the market data comprises NASDAQ Level II
Quotes.

4.   The display of claim 1 wherein the market data comprises data representing
      ticks, the data representing ticks further comprising tick times.

5.   The display of claim 4 wherein data representing ticks further comprises a
      symbol.

6.   The display of claim 4 wherein data representing ticks further comprises a tick
      direction.

7.   The display of claim 4 wherein data representing ticks further comprises a
      side.

8.   The display of claim 4 wherein the data representing ticks is stored in memory
      storage locations in computer memory.

9.   The display of claim 1 wherein the display area is divided into at least one
      display cell.

10.   The display of claim 9 wherein the information indicative of market activity
      comprises color values dependent upon market data and upon tick times, the
      color values displayed as colors in the display area.

11.   The display of claim 10 wherein, for each tick time stored in computer
      memory, one color value is calculated and displayed in one cell in the display
      area on the computer screen, each color value being displayed as a color in a
      separate cell.

12.   The display of claim 9 wherein, for each tick time stored in computer memory
      for a symbol, one color value is calculated and displayed in one cell in the
      display area on the computer screen, each color value being displayed as a
      color in a separate cell.

13.   The display of claim 9 wherein, for each tick time stored in computer memory
       for a symbol and a tick direction, one color value is calculated and displayed
       in one cell in the display area on the computer screen, each color value being
5   displayed as a color in a separate cell.

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14.   A display depicting market activity, the display comprising:

a display area disposed on a computer screen;

displayed in the display area, information indicative of market activity,

the information being dependent upon market data and tick

5   times, wherein the information indicative of market activity

comprises a list of top moving securities comprising a

predetermined number of securities, which list further

comprises a security occupying a bottom position in the list

("the bottom listed security"); and

10   automated computing machinery programmed to compute:

for a security identified by a symbol in data representing a tick

("the tick security"), a security momentum, said

security momentum being a numeric indication of

relative security price motion;

15   a security momentum for the bottom listed security;

a comparison of the security momentum of the tick security and

the security momentum of the bottom listed security;

replacement of the bottom listed security with the tick security

if the security momentum of the tick security is greater

20   than the security momentum of the bottom listed

security, thereby including the tick security in the list;

if the tick security is included in the list, a comparison of the

security momentum of the tick security and the security

momentum of a security just above the tick security in

25   the list; and

an exchange of the positions of the tick security and the

security just above the tick security in the list if the

security momentum of the tick security is greater than

the security momentum of the security just above the

30   tick security in the list.

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15. The display of claim 14 wherein, when computing a security momentum, the automated computing machinery also computes:

a time difference between a current time and stored tick times; and

a sum of the time differences so computed.

5

16.   A method of representing market activity, wherein market data dependent
upon market activity is received in a data stream through a communications
port, the method comprising the steps of:

   receiving a tick, said receiving further comprising extracting from said

5   data stream and from a clock data representing a tick, wherein data
representing a tick comprises a symbol and the time when the data
representing a tick is received ("tick time"); and

   creating a display dependent upon the data representing a tick, wherein
creating a display further comprises the steps of:

10   calculating a difference between the tick time and a
current time;

         calculating a color value according to the formula:

         color value = ((Y2-Y1)/(X2-X1))*(x-X1) + Y1,

                  wherein color value is the color value for

15   display,

         x is the time difference between the current time
                  and the tick time, the time difference
                  lying within a range of time differences,
                  the range of time differences having a

20   first value in the range of time
                  differences and a last value in the range
                  of time differences,

         X1 is the first value in the range of time
                  differences,

25   X2 is the last value in the range of time
                  differences,

         Y1 is a first value in a range of colors, the range
                  of colors having a first value in the range
                  of colors and a last value in the range of

30   colors, and

         Y2 is the last value in the range of colors; and

displaying the color value as a color on a computer screen.

17. The method of claim 16 further comprising storing the data representing a tick.

18. The method of claim 17 wherein the market data comprises NASDAQ Level II Quotes.

19. The method of claim 18 wherein ticks are represented by market data in the NASDAQ Level II Quotes.

20. The method of claim 16 wherein a tick is a change in a quoted price for a security.

21. The method of claim 16 wherein the data representing ticks comprises a security symbol.

22. The method of claim 21 wherein the data representing ticks further comprises a tick time.

23. The method of claim 22 wherein the data representing ticks further comprises a tick direction.

24. The method of claim 22 wherein the data representing ticks further comprises a side.

25. The method of claim 19, wherein storing data representing a tick further comprises determining the time the tick is received from NASDAQ ("tick time").

26.   The method of claim 18, wherein data representing a tick is received, storing
data representing a tick further comprising storing the time the data
representing the tick was received ("tick time") in a time array having a
number of ordered elements including a first element and a last element.

5

27.   The method of claim 26 further comprising:
           shifting the contents of the time array toward the last element, thereby
           emptying the first element and overwriting the last element; and
           storing the tick time in the first element.

10

28.   The method of claim 26, wherein creating a display further comprises
calculating a color value for each tick time stored in the time array, the color
values being dependent upon the corresponding tick times.

15   29.   The method of claim 28 further comprising periodically displaying colors
corresponding to the color values.

30.   The method of claim 18, wherein the step of creating a display further
comprises:

20   retrieving from computer memory the tick time stored in each element
                   of the time array;
           transforming each tick time in the time array into a color value; and
           displaying each color value as a color on a computer screen.

25   31.   The method of claim 30, wherein creating a display further comprises the
steps of:
           locating a display area on a video screen;
           dividing the display area into at least one cell;
           displaying in the cells on the video screen colors corresponding to the
30   color values.

32.   The method of claim 31, wherein the step of displaying colors in the cells on
       the video screen further comprises refreshing the display periodically.

33.   The method of claim 31, wherein the step of dividing the display area into
       cells further comprises dividing the display area into a number of cells
       dependent upon the number of ordered elements in the time array.

34.   The method of claim 30, wherein the step of transforming each tick time in the
       time array further comprises:
              calculating a time difference between a current time and the tick time
              stored in each element of the time array; and
              transforming the time difference into a color value.

35.   The method of claim 34, wherein the step of transforming the time differences
       into color values further comprises calculating a color value according to the
       formula:
              color value = $((Y2-Y1)/(X2-X1))*(x-X1) + Y1$, wherein
              color value is the color value for display,
              x is a time difference between the current time and the tick time stored
              in an element of the time array, the time difference lying within a range
              of time differences, the range of time differences having a first value in
              the range of time differences and a last value in the range of time
              differences,
              X1 is the first value in the range of time differences,
              X2 is the last value in the range of time differences,
              Y1 is the first value in a range of colors, the range of colors having a
              first value in the range of colors and a last value in the range of colors,
              and
              Y2 is the last value in the range of colors.

36. A method of representing market activity, wherein market data dependent
upon market activity is received in a data stream through a communications
port, the method comprising the steps of:

   receiving a tick, said receiving further comprising extracting from said
5   data stream and from a clock data representing a tick, wherein
                 data representing a tick comprises a symbol and the time when
                 the data representing a tick is received ("tick time"), said
                 receiving further comprising storing in computer memory the
                 data representing a tick including storing the tick times; and
10   creating a display dependent upon the data representing a tick, wherein
                 creating a display comprises generating a list of top moving
                 securities dependent upon the data representing a tick, the list
                 comprising securities having the highest security momenta, the
                 list comprising at least one security and a bottom listed
15   security, the generating of the list further comprising the steps
                 of:

                    calculating from the stored tick times a security
                          momentum for the security identified by the
                          symbol in the data representing the tick ("the
20   tick security"), said security momentum being a
                          numeric indication of relative security price
                          motion;
                    calculating a security momentum of the bottom listed
                          security;
25   comparing the security momentum of the tick security
                          with the security momentum of the bottom listed
                          security.
                    if the comparison shows that the security momentum of
                          the tick security is greater than the security
30   momentum of the bottom listed security, the
                          method further comprising replacing the bottom

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listed security with the tick security;

calculating the security momentum for the security just
above the tick security on the list;

comparing the security momentum of the security just

5

above the tick security and the security
momentum of the tick security;

if the comparison shows that the security momentum of
the tick security is greater than the security
momentum of the security just above the tick

10

security on the list, swapping the positions of the
tick security and the security just above the tick
security on the list.

37. The method of claim 46, wherein the step of calculating from the stored tick

15   times a security momentum further comprises:

calculating time differences between a current time and stored tick
times; and summing the calculated time differences.

38. The method of claim 36, further comprising displaying on a computer screen

20   the list of securities with the highest security momenta, each security in the list
having a display location on the computer screen.

39. The method of claim 38 further comprising the steps of:

transforming each stored tick time into a color value wherein

25   transforming further comprises calculating the color values according
to the formula:

color value = $((Y2-Y1)/(X2-X1))*(x-X1) + Y1$, wherein
color value is the color value for display,
x is a time difference between a current time and the

30   tick time, the time difference lying within a
range of time differences, the range of time

differences having a first value in the range of
time differences and a last value in the range of
time differences,

X1 is the first value in the range of time differences,

5   X2 is the last value in the range of time differences,

Y1 is a first value in a range of colors, the range of
colors having the first value in the range of
colors and a last value in the range of colors, and

Y2 is the last value in the range of colors; and

10   displaying each color value as a color on the computer screen at a color
display location dependent upon the display location of each security
in the list.

40.   The method of claim 39, wherein displaying each color value further

15   comprises:

locating a color display area on a video screen dependent upon the
display locations of the securities in the list;
dividing the color display area into at least one cell; and
displaying in the cells on the video screen colors corresponding to the

20   color values.

41.   The method of claim 38 further comprising displaying in the form of text the
list of securities with the highest security momenta, the text showing the
symbols of the securities with the highest security momenta, each symbol

25   having a display location on the computer screen.

42.   The method of claim 41 further comprising the steps of:
transforming each stored tick time into a color value, wherein the
transforming further comprises calculating a color value

30   according to the formula:
color value = $((Y2-Y1)/(X2-X1))*(x-X1) + Y1$, wherein

color value is the color value for display,

x is a time difference between the current time and the

tick time stored in an element of the time array,

the time difference lying within a range of time

5   differences, the range of time differences having

a first value in the range of time differences and

a last value in the range of time differences,

X1 is the first value in the range of time differences,

X2 is the last value in the range of time differences,

10   Y1 is the first value in a range of colors, the range of

colors having a first value in the range of colors

and a last value in the range of colors, and

Y2 is the last value in the range of colors; and

displaying each color value on the computer screen at a color display

15   location dependent upon the display location of each symbol.

43.   The method of claim 41, wherein displaying each color value further

comprises:

locating a color display area on a video screen dependent upon the

20   display locations of the symbols;

dividing the color display area into at least one cell; and

displaying in the cells on the video screen colors corresponding to the

color values.

25 44.   The method of claim 38, wherein the list of securities with the highest security

momenta is displayed in the form of a bar chart.

45.   A system, implemented in software on a digital computer, for depicting market activity, wherein the market activity is represented by a data stream, received through a communications port, the system comprising:

    means for storing data representing a tick, wherein data representing a tick includes a tick time; and

    means for creating a display dependent upon the data representing a tick, wherein the display comprises colors dependent upon color values, the means for creating further comprising means for calculating the color values according to the formula:

    color value = $((Y2-Y1)/(X2-X1))*(x-X1) + Y1$, wherein color value is the color value for display,

    x is a time difference between a current time and the tick time, the time difference lying within a range of time differences, the range of time differences having a first value in the range of time differences and a last value in the range of time differences,

    X1 is the first value in the range of time differences,

    X2 is the last value in the range of time differences,

    Y1 is a first value in a range of colors, the range of colors having the first value in the range of colors and a last value in the range of colors, and

    Y2 is the last value in the range of colors.

46.   The system of claim 45 further comprising means for receiving the data stream.

47.   The system of claim 46, wherein the data stream comprises NASDAQ Level II Quotes.

48. The system of claim 47, wherein ticks are represented by data in the NASDAQ Level II Quotes.

49. The system of claim 45, wherein a tick is a change in a quoted price for a security.

50. The system of claim 45, wherein the data representing ticks comprises a security symbol.

51. The system of claim 50, wherein the data representing ticks further comprises a tick direction.

52. The system of claim 50, wherein the data representing ticks further comprises a side.

53. The system of claim 47, wherein data representing a tick is received, means for storing data representing a tick further comprising means for storing the time the data representing the tick was received ("tick time") in a time array having a number of physical computer memory locations including a first memory location and a last memory location.

54. The system of claim 53 further comprising:
    means for shifting the contents of the time array toward the last memory location, thereby emptying the first memory location and overwriting the last memory location; and
    means for storing the tick time in the first memory location.

55. The system of claim 53, wherein means for creating a display further comprises means for calculating a color value for each tick time stored in the time array, the color values being dependent upon the tick times.

39

56.   The system of claim 55, further comprising means for periodically displaying
        colors corresponding to the color values.

57.   The system of claim 53, wherein means for creating a display further
5   comprises:

                means for retrieving from computer memory the tick time stored in
                each memory location of the time array;
                means for transforming each tick time in the time array into a color
                value; and
10   means for displaying each color value onto a computer screen. .

58.   The system of claim 53, wherein means for creating a display further
        comprises:

                means for locating a display area on a video screen;
15   means for dividing the display area into at least one cell; and
                means for displaying in the cells on the video screen colors
                corresponding to the color values.

59.   The system of claim 58, wherein means for displaying colors in the cells on
20   the video screen further comprises means for refreshing the display
        periodically.

60.   The system of claim 58, wherein the means for dividing the display area into
        cells further comprises means for dividing the display area into a number of
25   cells dependent upon the number of memory locations in the time array.

61.   The system of claim 57, wherein the means for transforming each tick time in
        the time array further comprises:

                means for calculating a time difference between a current time and the
30   tick time stored in each memory location of the time array; and
                means for transforming the time difference into a color value.

62.   The system of claim 61, wherein the means for transforming the time
       differences into color values further comprises means for calculating a color
       value according to the formula:

5   color value = ((Y2-Y1)/(X2-X1))*(x-X1) + Y1, wherein
               color value is the color value for display,
               x is a time difference between the current time and the tick time stored
               in a memory location of the time array, the time difference lying
               within a range of time differences, the range of time differences having
10   a first value in the range of time differences and a last value in the
               range of time differences,
               X1 is the first value in the range of time differences,
               X2 is the last value in the range of time differences,
               Y1 is the first value in a range of colors, the range of colors having a
15   first value in the range of colors and a last value in the range of colors,
               and
               Y2 is the last value in the range of colors.

63. A system, implemented in software on a digital computer, for depicting
market activity, wherein the market activity is represented by a data stream,
received through a communications port, the system comprising:

    means for storing data representing a tick, wherein data representing a
tick includes a tick time; and

    means for creating a display dependent upon the data representing a
tick, the means for creating a display further comprising means
for generating a list of top moving securities dependent upon
the data representing a tick, the list of top moving securities
comprising securities having the highest security momenta, the
list comprising at least one listed security and a bottom listed
security, the means for generating a list further comprising:

        means for calculating from the stored tick times a
security momentum for the security identified by
the symbol in the data representing the tick ("the
tick security"), said security momentum being a
numeric indication of relative security price
motion;

        means for calculating a security momentum of the
bottom listed security;

        means for comparing the security momentum of the tick
security with the security momentum of the
bottom listed security;

        means for replacing the bottom listed security with the
tick security if the security momentum of the
tick security is greater than the security
momentum of the bottom listed security;

        means for calculating, if the tick security is on the list,
the security momentum for the security just
above the tick security on the list;

        means for comparing the security momentum of the

42

security just above the tick security on the list

and the security momentum of the tick security;

means for swapping the positions of the tick security

and the security just above the tick security on

5   the list if the momentum of the tick security is

greater than the security momentum of the

security just above the tick security on the list.

64.   The system of claim 63, wherein the means for calculating from the stored tick

10   times a security momentum further comprises:

means for calculating time differences between a current time and

stored tick times; and

means for summing the calculated time differences.

15   65.   The system of claim 63 further comprising means for displaying on a

computer screen the list of securities with the highest security momenta, each

security in the list having a display location on the computer screen.

66.   The system of claim 65 further comprising:

20   means for transforming each stored tick time into a color value, further

comprising means for calculating the color values according to

the formula:

color value = $((Y2-Y1)/(X2-X1))*(x-X1) + Y1$, wherein

color value is the color value for display,

25   x is a time difference between a current time and the

tick time, the time difference lying within a

range of time differences, the range of time

differences having a first value in the range of

time differences and a last value in the range of

30   time differences,

X1 is the first value in the range of time differences,

X2 is the last value in the range of time differences,

Y1 is a first value in a range of colors, the range of
colors having the first value in the range of
colors and a last value in the range of colors, and

Y2 is the last value in the range of colors; and

means for displaying each color value on the computer screen at a
color display location dependent upon the display location of each
security in the list.

67. The system of claim 66, wherein means for displaying each color value further
comprises:

means for locating a color display area on a video screen dependent
upon the display locations of the securities in the list;
means for dividing the color display area into at least one cell; and
means for displaying in the cells on the video screen colors
corresponding to the color values.

68. The system of claim 65 further comprising means for displaying the list of
securities with the highest security momenta in the form of text showing the
symbols of the securities with the highest security momenta, each symbol
having a display location on the computer screen.

69. The system of claim 68 further comprising:

means for transforming each stored tick time into a color value; and
means for displaying each color value on the computer screen at a
color display location dependent upon the display location of each
symbol.

70.   The system of claim 69, wherein means for displaying each color value further comprises:

        means for locating a color display area on a video screen dependent upon the display locations of the symbols;

5   means for dividing the color display area into at least one cell; and

        means for displaying in the cells on the video screen colors corresponding to the color values.

71.   The system of claim 65, wherein the list of securities with the highest security

10   momenta is displayed in the form of a bar chart.

1 / 20

102 DATA STREAM

104 COMMUNICATION PORT

106 RECEIVING

108 NASDAQ QUOTES

114 STORING

112 DATA REPRESENTING TICKS

116 CREATING

119 DISPLAYS

FIG. 1

NASDAQ Level II Quote						~~108

202~ Symbol
204~ LastTradePrice
206~ ClosePrice
208~ NetChange
209~ NationalMarket
210~ TypicalQuantity
212~ TickDirection
214~ High
216~ Low

Side	Quantity	MMID	Price		
Side	Quantity	MMID	Price		
Side	Quantity	MMID	Price		
Side	Quantity	MMID	Price		
Side	Quantity	MMID	Price		
Side	Quantity	MMID	Price		
Side	Quantity	MMID	Price		
Side	Quantity	MMID	Price		

218   220   222   224

FIG. 2

//Data Representing Ticks data structure

```
struct Arrays
{
    306~  {  time_t UpTicks[12];        ~~200
            time_t DownTicks[12];      ~~292
}
```

FIG. 2A

```
struct DatatRepresentingTicks ~~112
{
    string symbol;
    Arrays bid;
    Arrays ask;
}
```

3 / 20

302   304

| FIRST ELEMENT | | o o o | | LAST ELEMENT |

FIG. 3

306

306

Calculate   310

FIG. 3A

Color Value   312

314   Display

122

316

306 — 402

406 — Retrieving

404 — Tick Time

408 — Transforming

410 — Color Value

412 — Displaying

120 — 414
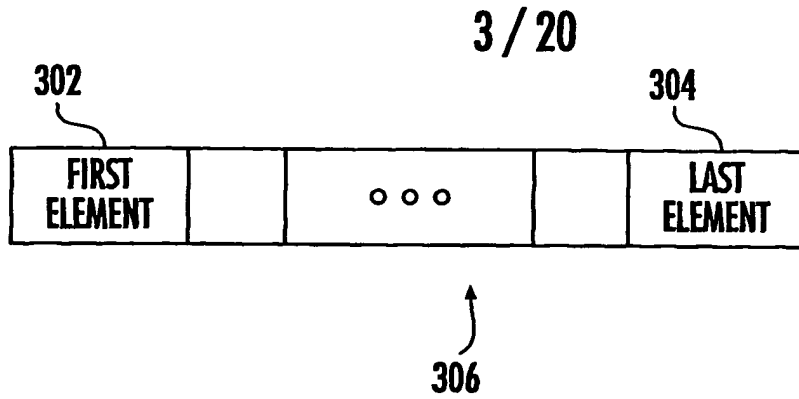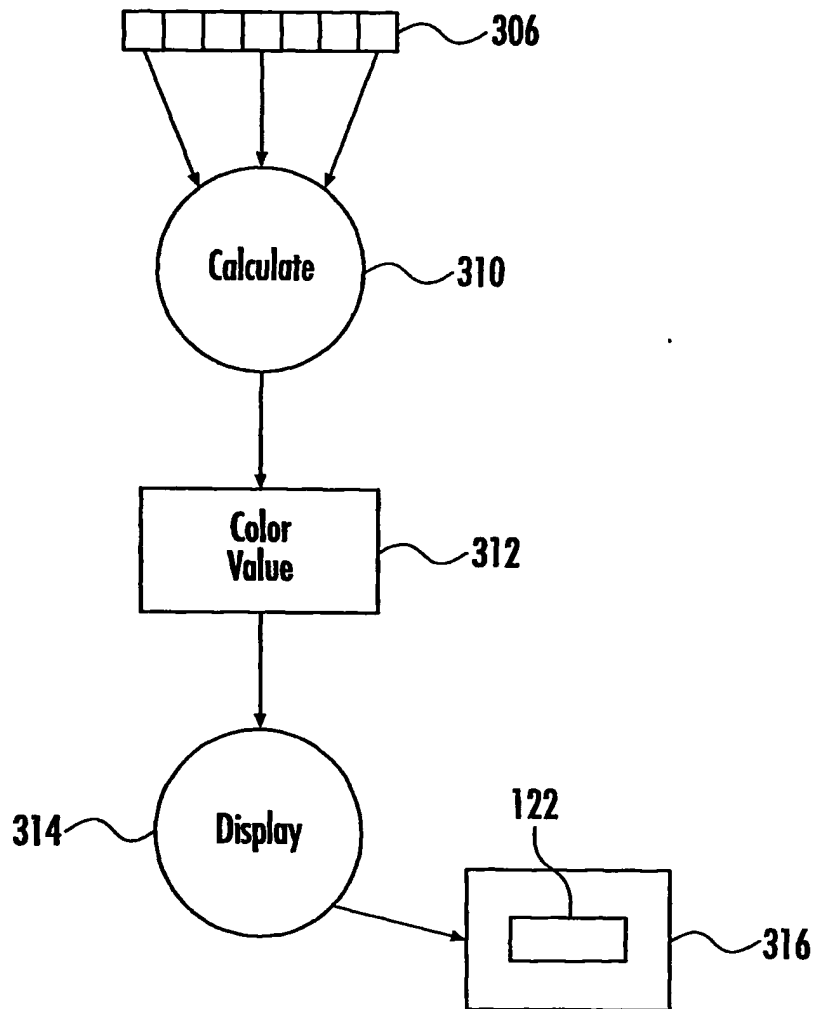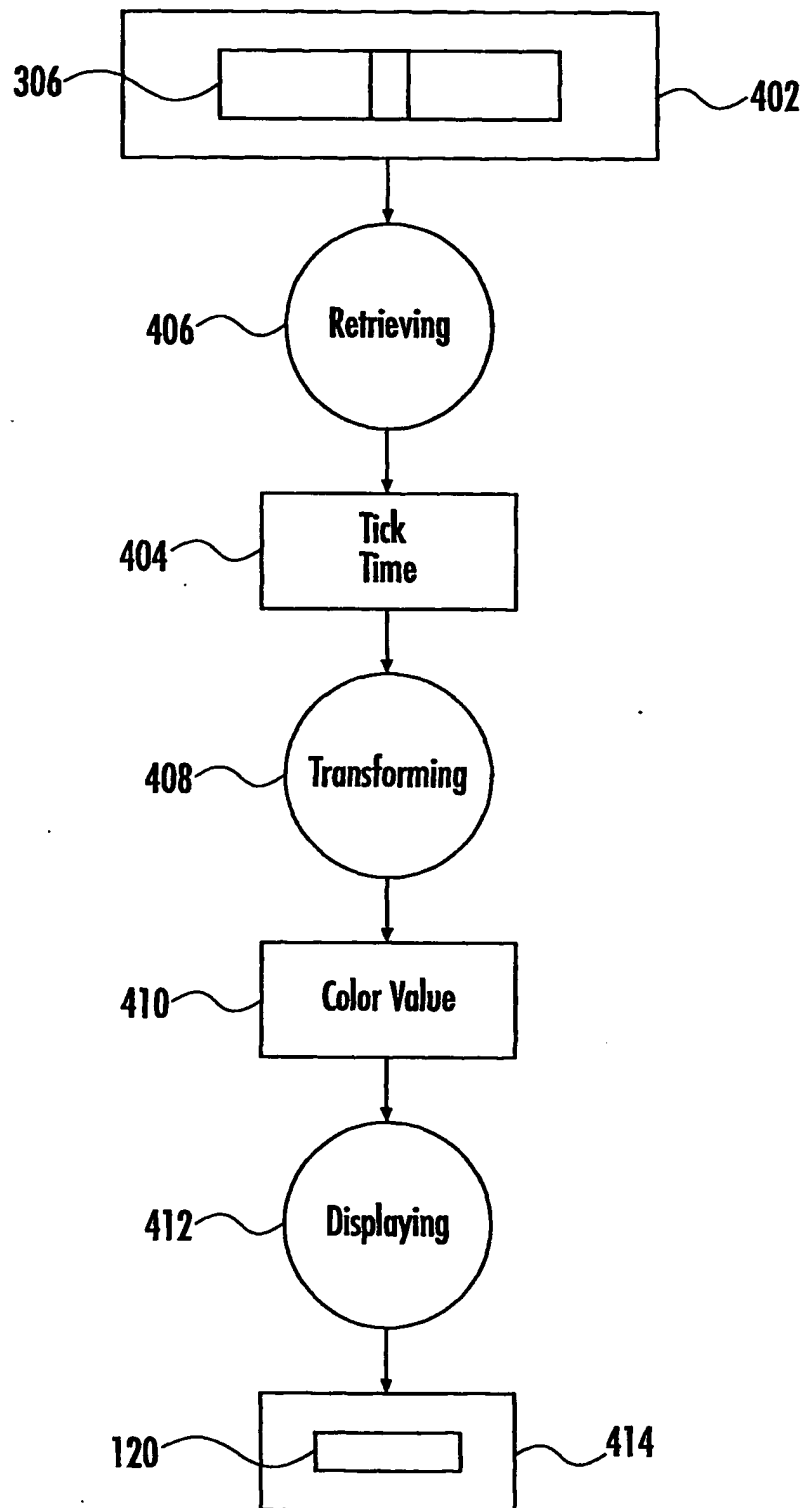
FIG. 4

```
// t():          function transform the tick times stored in the time array into color values
        //              t is called periodically to transform and display the color values


        void t(TimeArray TickTimes)
        {
                // CutOff is the maximum time difference allowed
                // BeginColor is the starting color for display
                // EndColor is the ending color for the display
                for i = first element to last element
                {
                        ColorValue = f(TickTimes[i], CutOff, BeginColor, EndColor);
                        display(ColorValue)
                }
        }


//f():        function transforms time value into color

color f(time TickTime, TimeDiff CutOff, color begin, color end)
{
        time curtime = now();
        TimeDiff diff = CurTime - TickTime;
        if(diff < 0)diff = 0;
        if(diff > CutOff)diff = CutOff;
                // the time difference calculated cannot be more than the cutoff

        return RGB(   lt(diff,0,CutOff,RED(begin),RED(end)),
                      lt(diff,0,CutOff,GREEN(begin),GREEN(end)),
                      lt(diff,0,CutOff,BLUE(begin),BLUE(end)));

}



//lt():        function does linear transformation [X1,X2] -> [Y1,Y2]
// calculates the value between the begin and end color values that correspond
        to the time difference value

float lt(float x, float X1,float X2,float Y1,float Y2)
{
        float y - ((Y2 - Y1)/(X2 - X1)) * (x - X1) + Y1;
        return y;
}


//RGB():     function builds a color value from its given red, green and blue components
//RED(), GREEN(), BLUE():        functions extract particular color component from
```
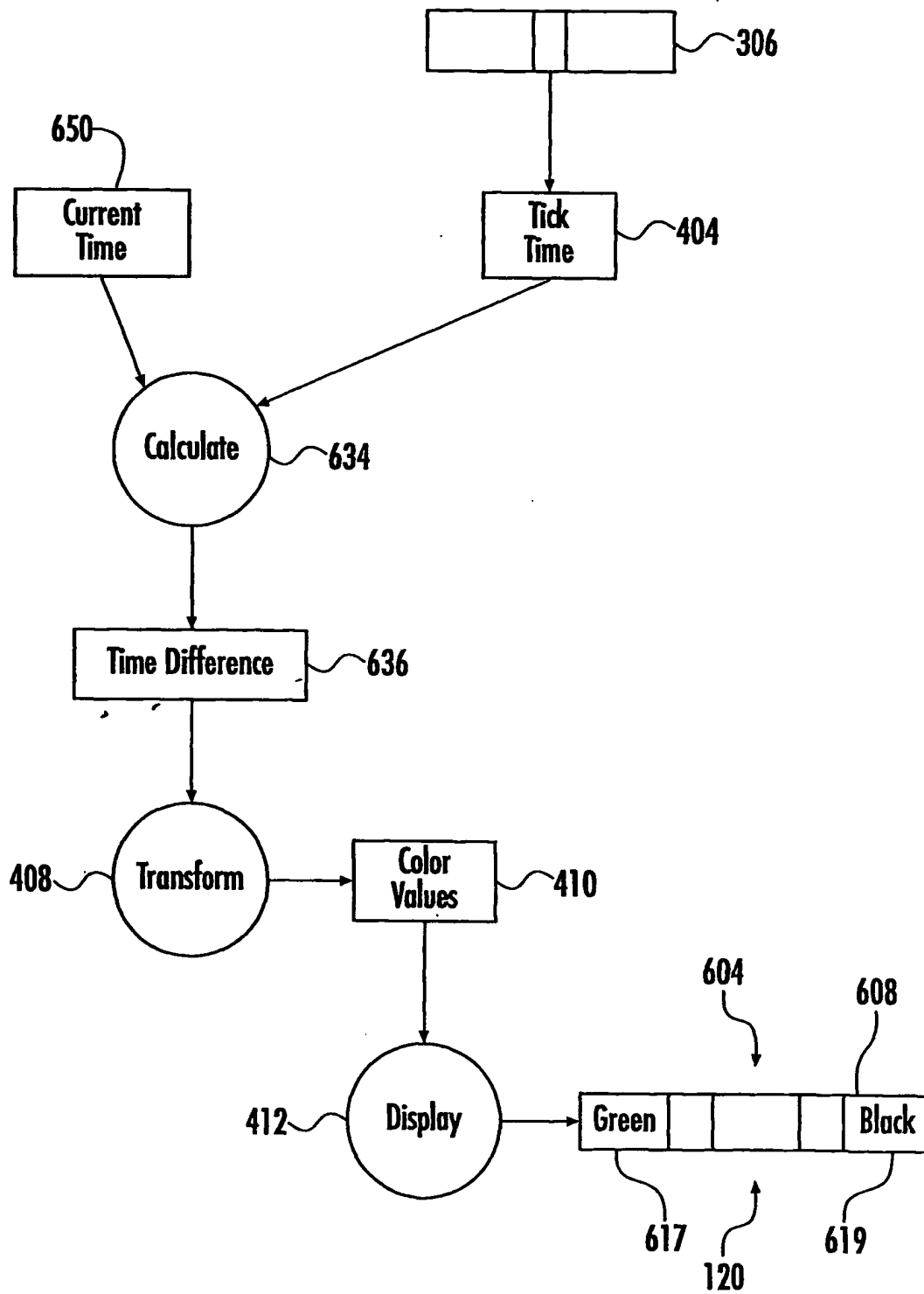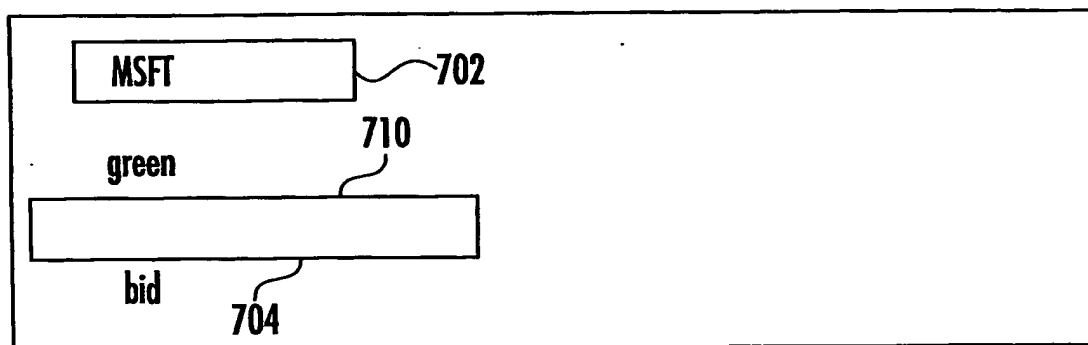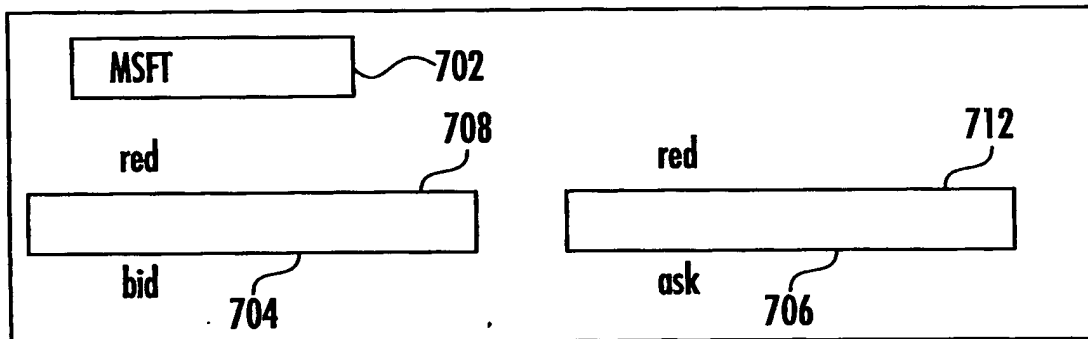
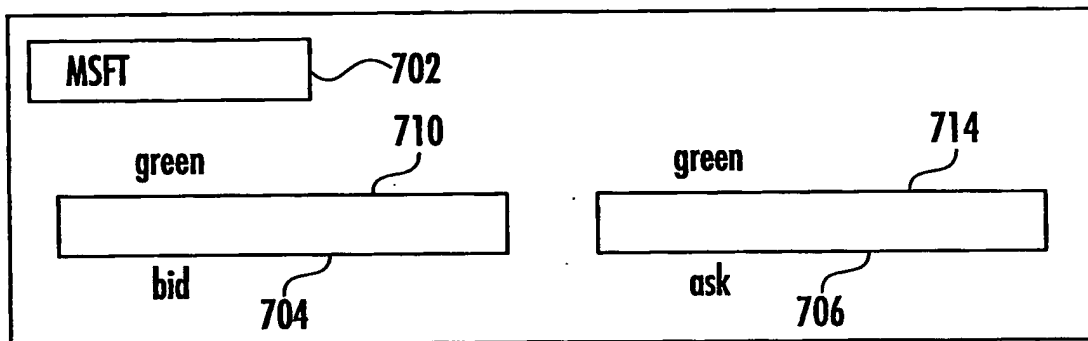FIG. 5

FIG. 6

FIG. 6A

FIG. 6B

FIG. 7A

FIG. 7B

FIG. 7C

FIG. 7D

MSFT ⟋702

708

red

bid

704

FIG. 7E

MSFT ⟋702

714

green

ask

706

FIG. 7F

MSFT ⟋702

712

red

ask

706

FIG. 7G

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FIG. 8

930

306

CURRENT
TIME

TICK TIME — 806

934

CALCULATE
TIME
DIFFERENCES

TIME DIFFERENCE — 936

814

938 — SUM

SECURITY
MOMENTUM

FIG. 9A
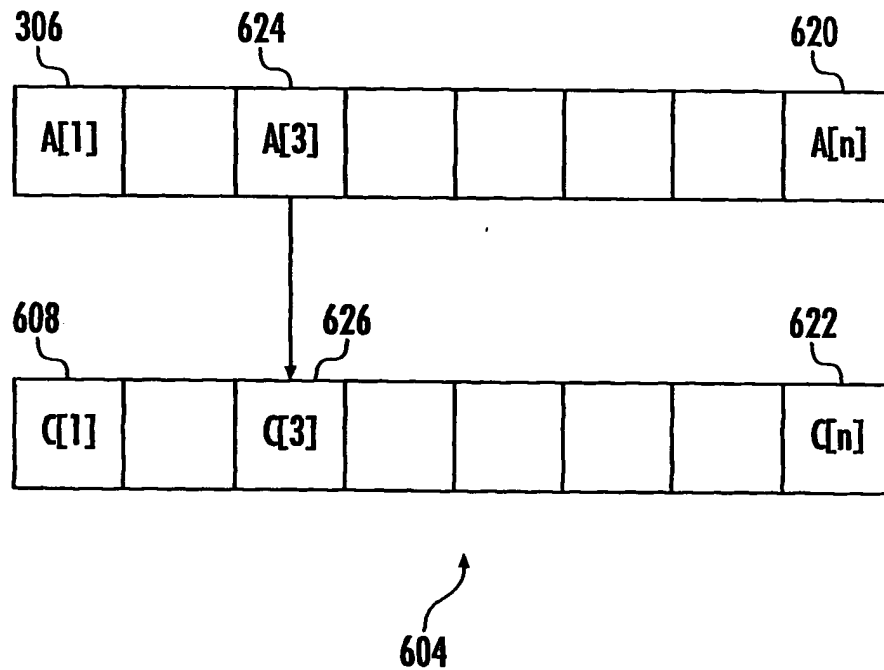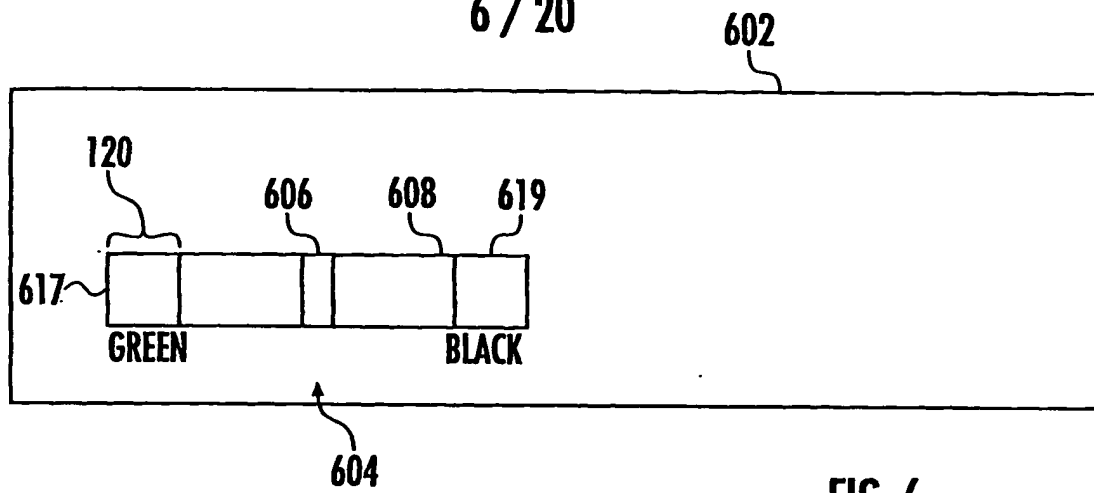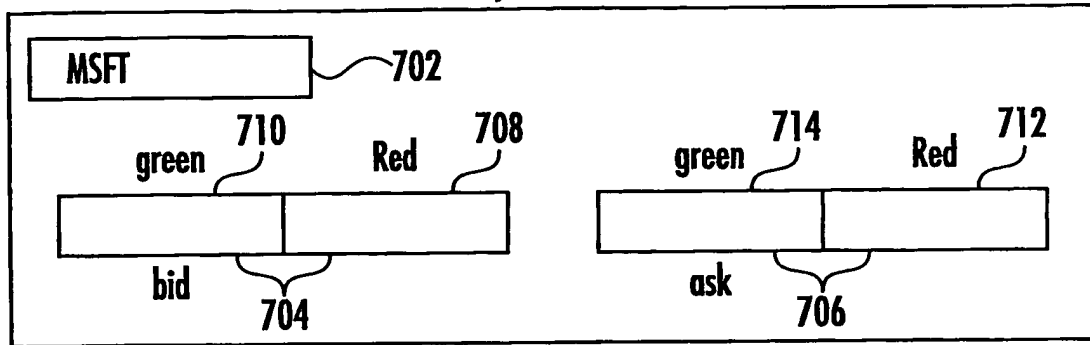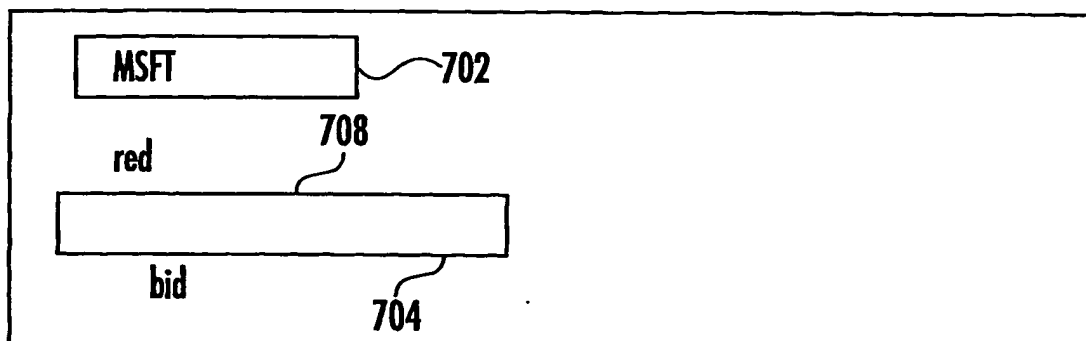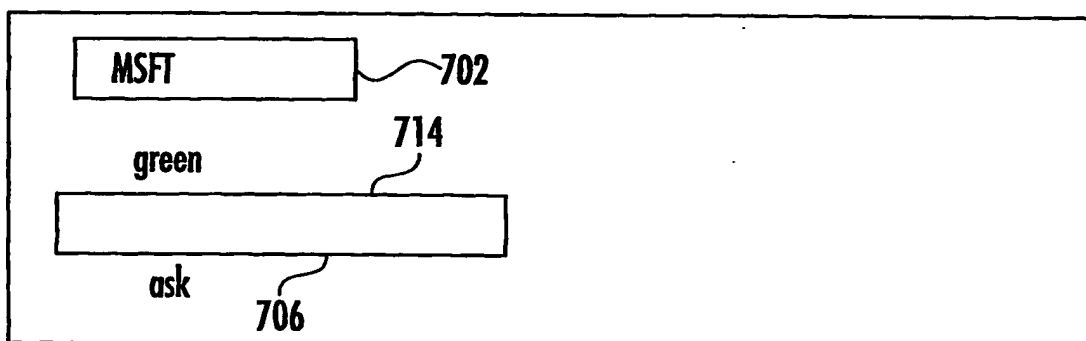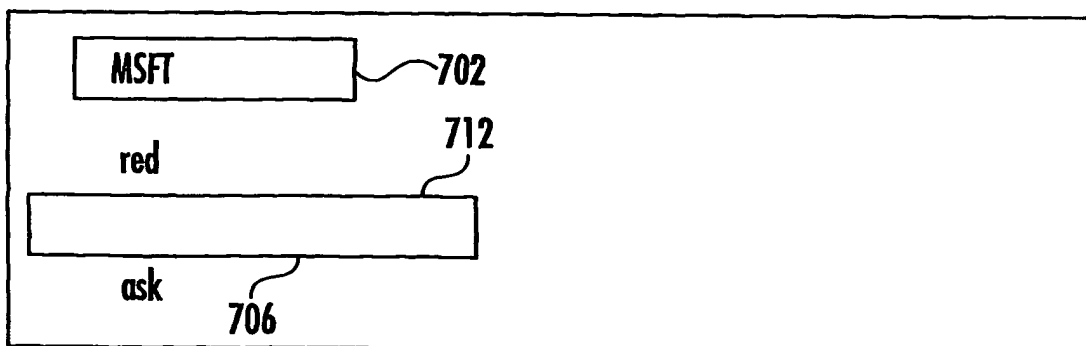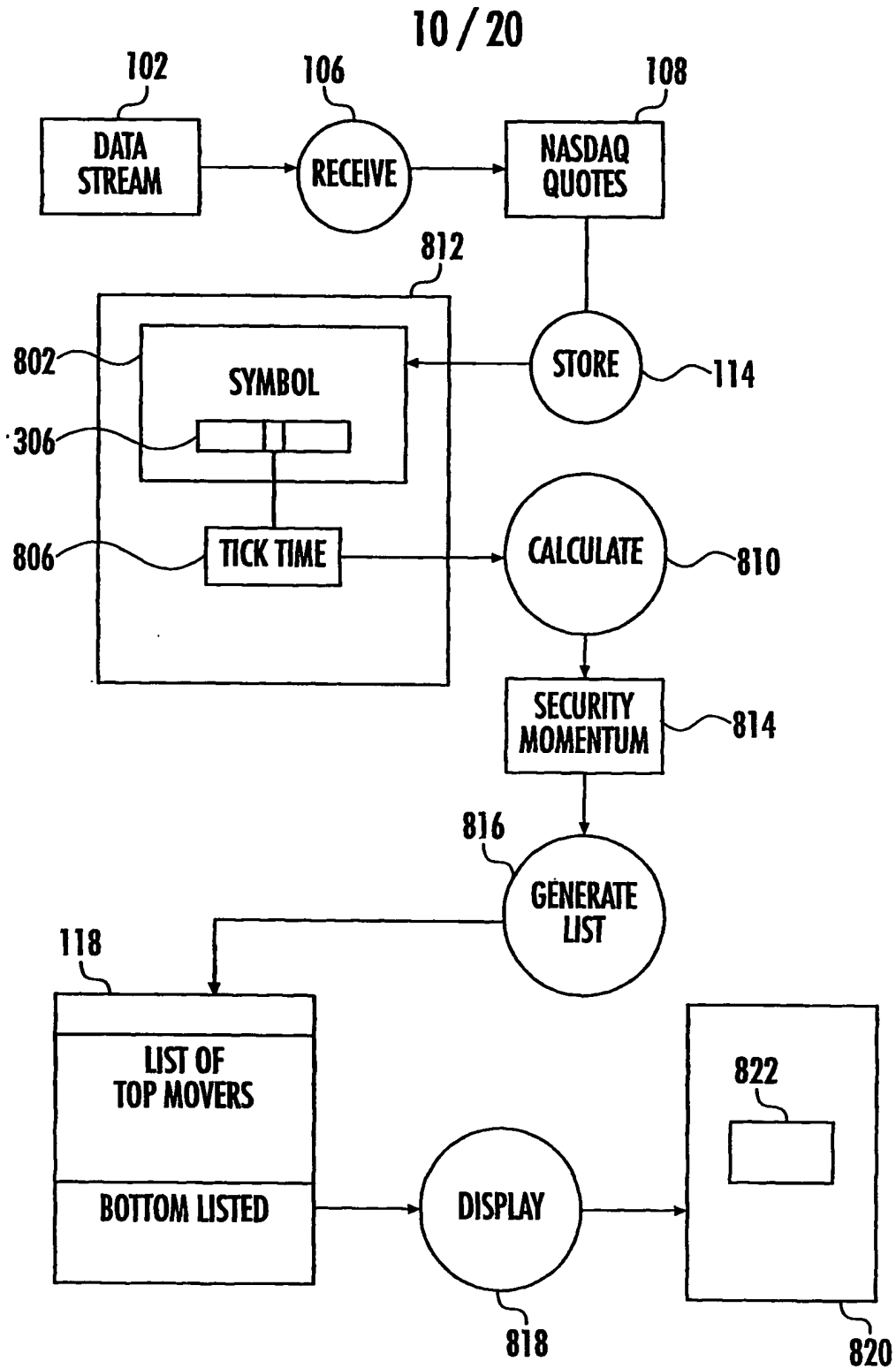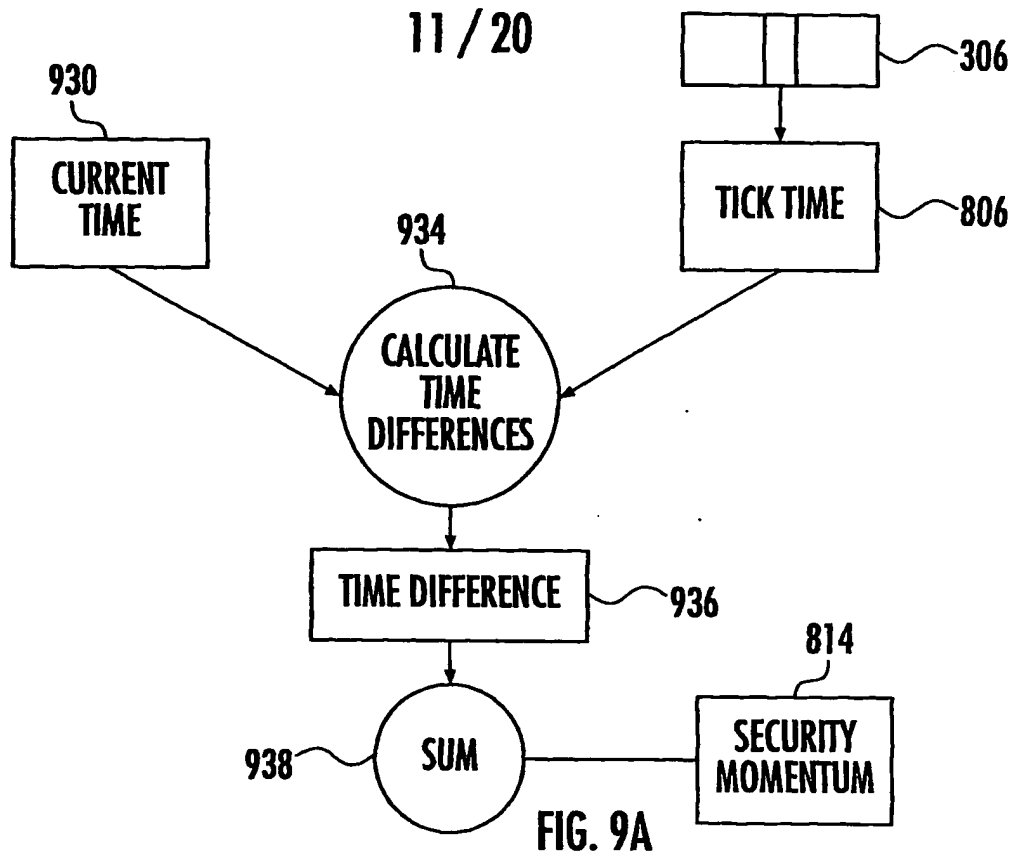
```
struct Movement    803    804                  FIG. 9B                    802
    {
        char    Symbol[4] ; // identify security
        time_t TickTimes[12]; // stores the tick times for the security identified by
                                        // symbol
    }                         806

CalculateSecurityMomentum(Movement*pTickSecurity)
{

    {
        int     i, delta, SecurityMomentum = 0;
        time_t          CurrentTime = time();

        for(i=0; i<12; i++))
        {
            delta = CurrentTime - pTickSecurity -> tick_times[i];
            if (delta>12) break; // exit for()
            SecurityMomentum += 12 - delta;
        }
        return(SecurityMomentum);
    }
}
```
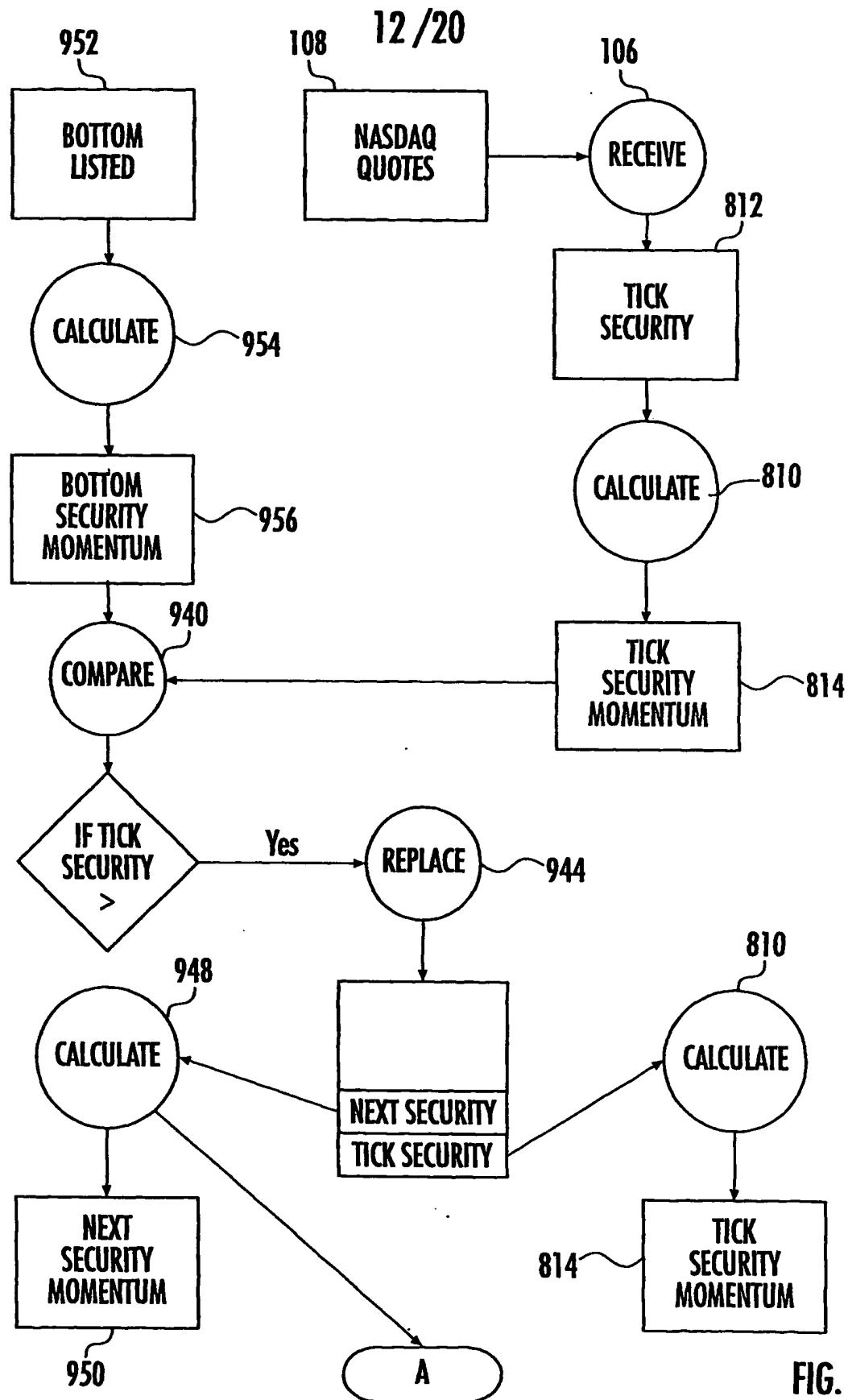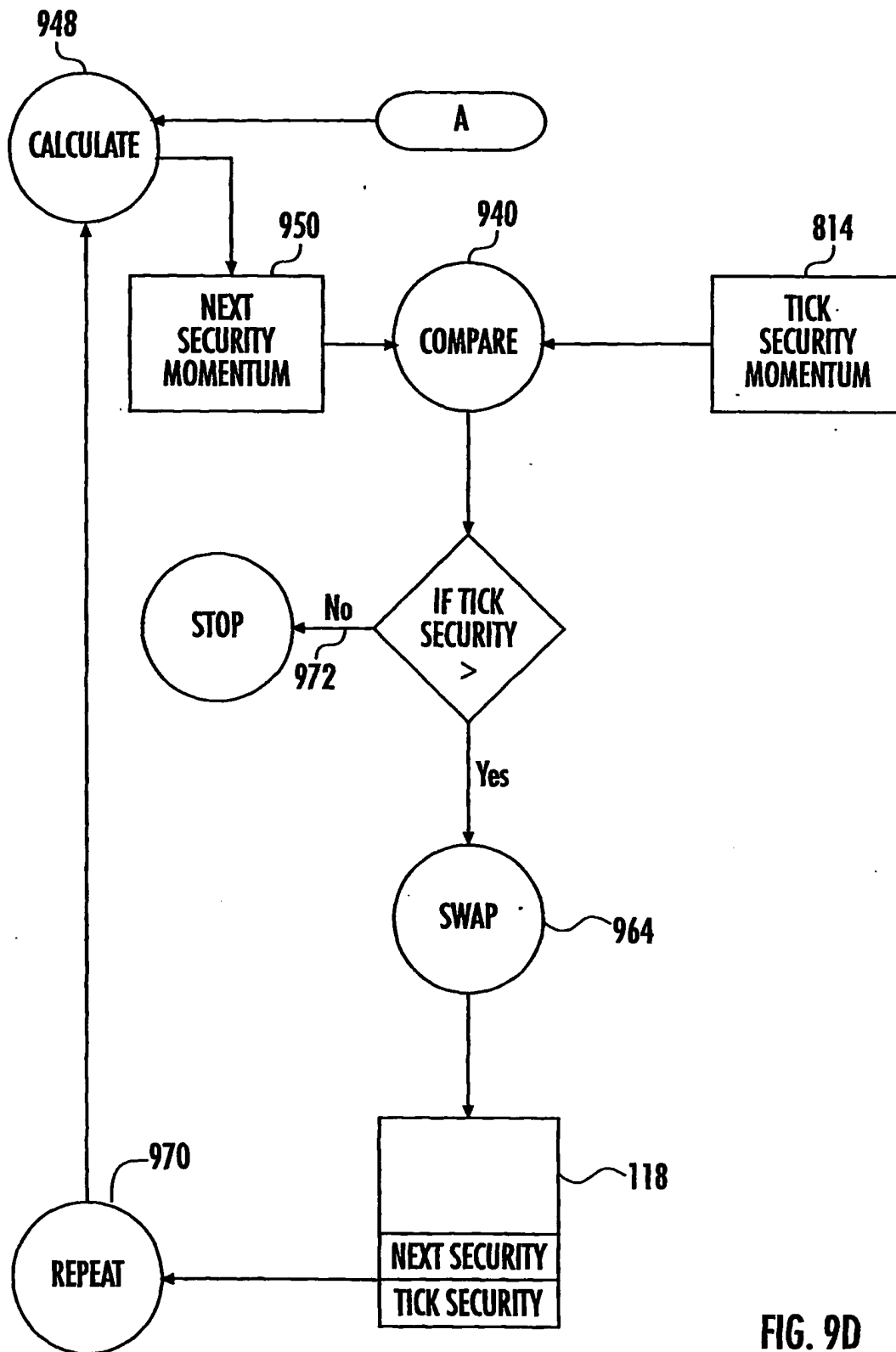
12 /20

952

BOTTOM
LISTED

108

NASDAQ
QUOTES

106

RECEIVE

812

TICK
SECURITY

CALCULATE 954

CALCULATE 810

BOTTOM
SECURITY
MOMENTUM 956

TICK
SECURITY
MOMENTUM 814

940

COMPARE

IF TICK
SECURITY
>

Yes

REPLACE 944

948

CALCULATE

NEXT SECURITY

TICK SECURITY

CALCULATE

810

NEXT
SECURITY
MOMENTUM

TICK
SECURITY
MOMENTUM 814

950

A

FIG. 9C

13 / 20

948

CALCULATE ← A

950   940   814

NEXT
SECURITY → COMPARE ← TICK
MOMENTUM   SECURITY
                      MOMENTUM

STOP ← No ← IF TICK
            SECURITY
972   >

            Yes

            SWAP —964

970

REPEAT ← 118

NEXT SECURITY

TICK SECURITY

FIG. 9D

14 / 20

```
Generate_List_top_Movers()
        // the function calculate_security_momentum() accepts a security and
        //calculates its security momentum value
{

        ReceivedSecurityMomentum = CalculateSecurityMomentum( ReceivedSecurity);
        BottomListedSecurityMomentum =
                        CalculateSecurityMomentum(SecurityList[BottomOfList]);
        If ReceivedSecurityMomentum > BottomListedSecurityMomentum
        {

                SecuritiesList[BottomOfList] = ReceivedSecurity;
                        // place received security on bottom of list
                for index = BottomOfList to TopOfList
                {

                        // this loop bubbles the received security to the top of the list
                        CurrentSecurityMomentum =
                                        CalculateSecurityMomentum(SecuritiesList[index-1]);
                        If ReceivedSecurityMomentum > CurrentSecurityMomentum
                        //received security is always in SecuritiesList[index]
                        Then
                                Swap positions of SecuritiesList[index-1] and SecuritiesList[index]
                        Else break the loop
                }
        }
}
```
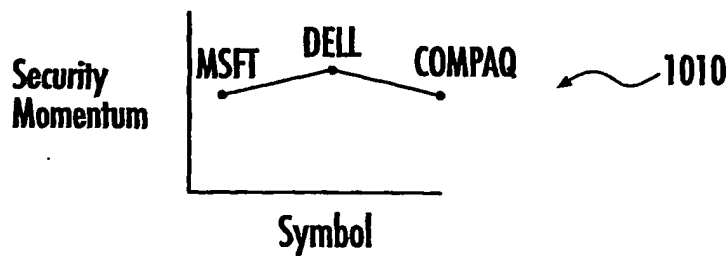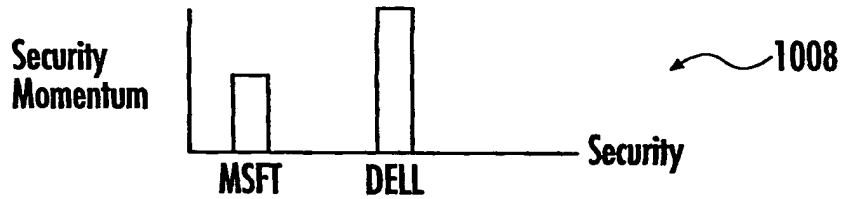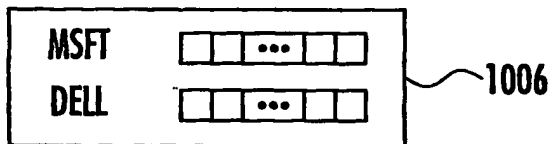
FIG. 9E

MSFT
DELL
～1002

～1004

MSFT [] [] ••• []
DELL [] [] ••• []
～1006

Security
Momentum
MSFT   DELL   Security
～1008

Security
Momentum
MSFT   DELL   COMPAQ
Symbol
～1010

FIG. 10

16 / 20
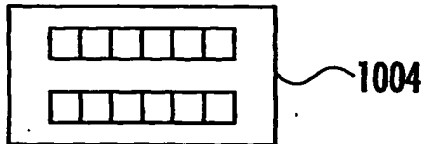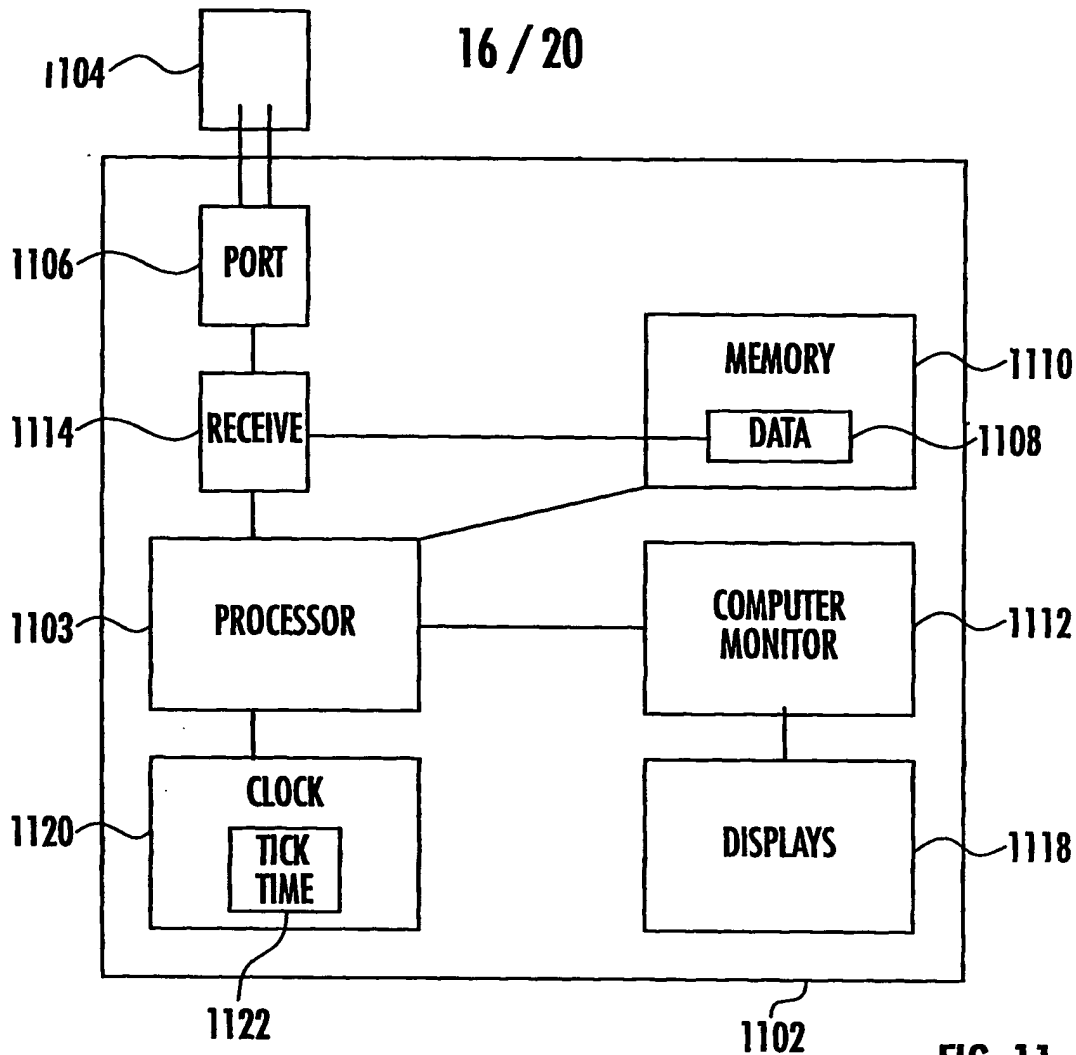

FIG. 11

//Data Representing Ticks data structure

```
struct TickDirection                1206
{
        time_t  UpTicks[12];        1208
        time_t  DownTicks[12];      1210
}
```

FIG. 12

```
struct DataRepresentingTicks        1108
{
        string symbol;
        TickDirection bid;          1210
        TickDirection ask;          1212  }    1208
}
```
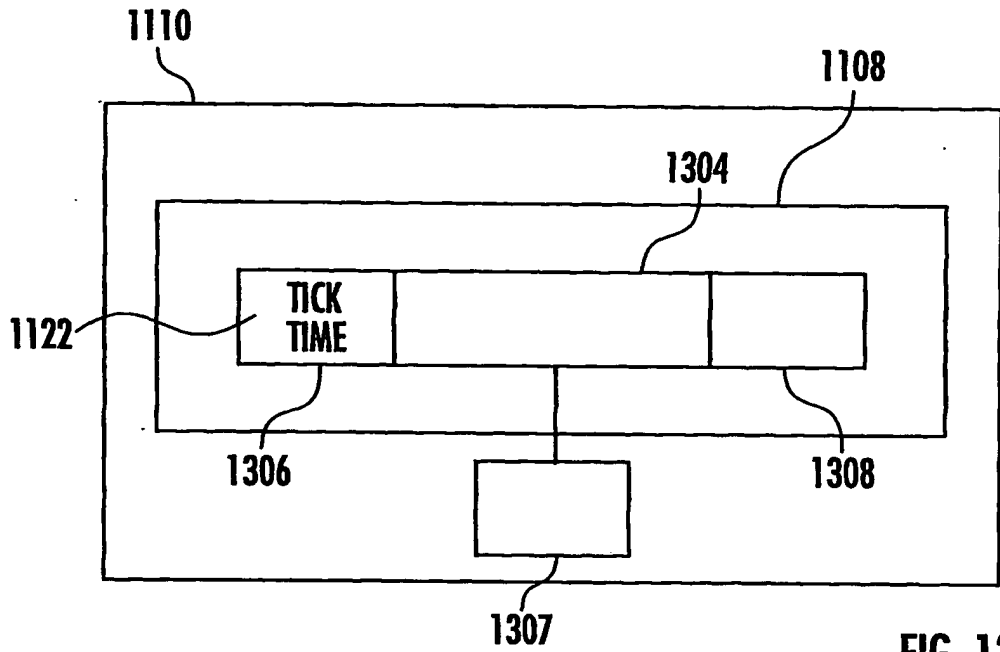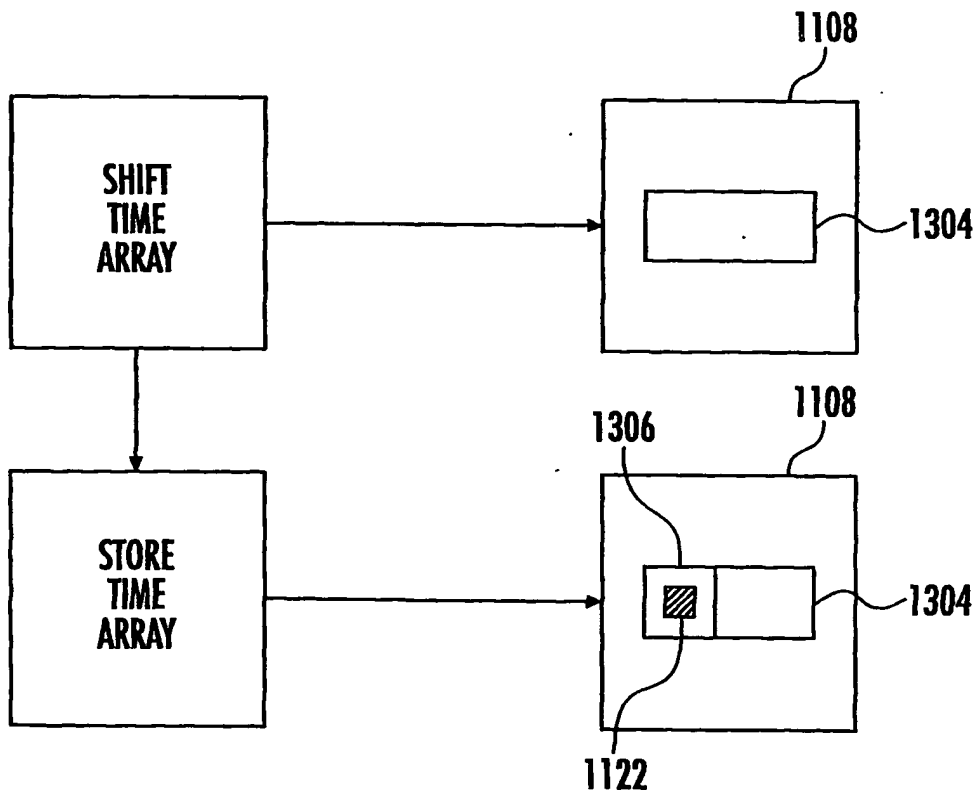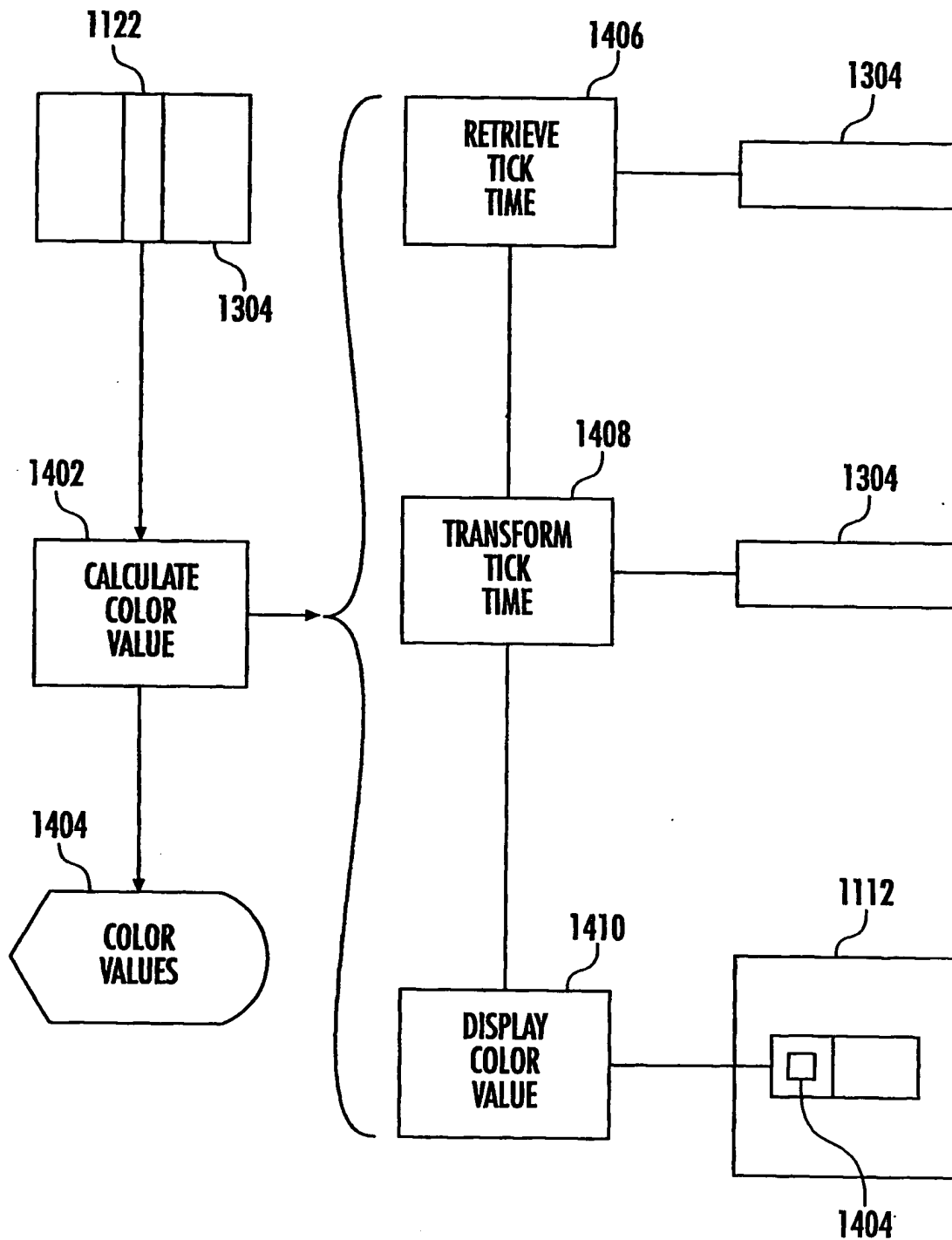
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1110

1108

1304

TICK
TIME

1122

1306   1308

1307

FIG. 13

1108

SHIFT
TIME
ARRAY   1304

1108

1306

STORE
TIME
ARRAY   1304

1122

FIG. 13A

FIG. 14

1502

CALCULATE
TIME
DIFFERENCE

CURRENT
TIME

1304

1408

TRANSFORM

TIME
DIFFERENCE

1510

FIG. 15

1122   1404

TRANSFORM
TIME
DIFFERENCE

COLOR
VALUE

1504

1112   1404   1604

C[m]

LOCATE
DISPLAY
AREA

1610

1606

DIVIDE
DISPLAY
AREA

1612

1304

A[n]

DISPLAY
COLOR
VALUE

1614

FIG. 16

20 / 20

1112
1704
1706

1122   1304

1702

GENERATE
LIST

CALCULATE
SECURITY
MOMENTUM
1720

SECURITY
MOMENTUM   1715

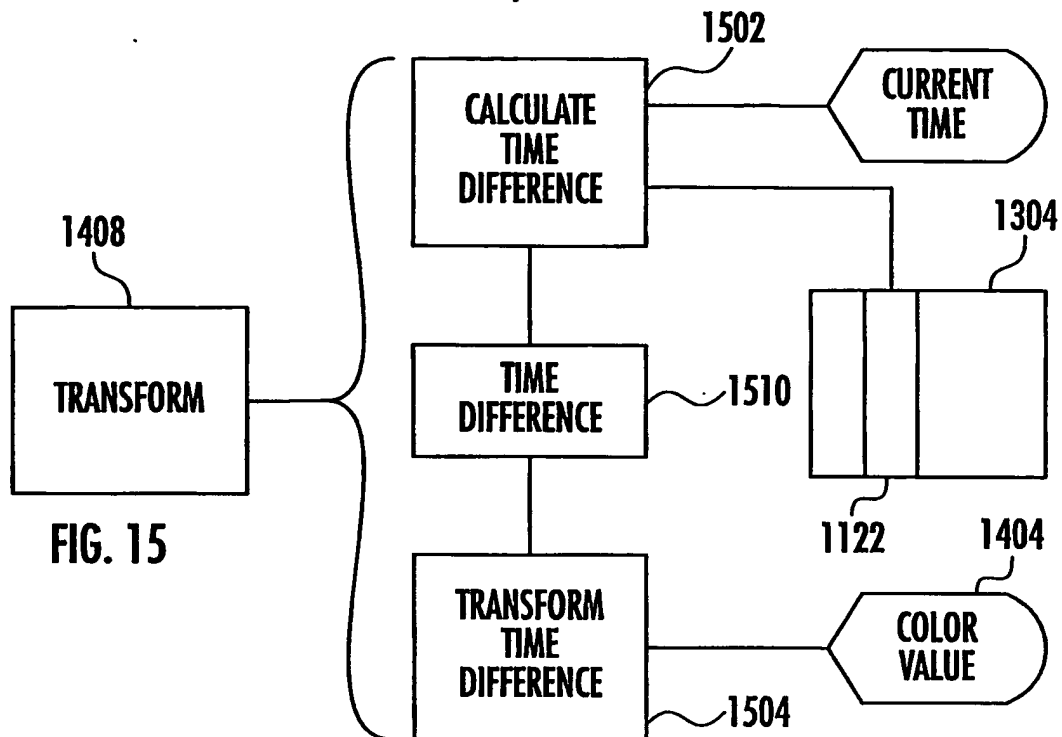1704

1722

GENERATE
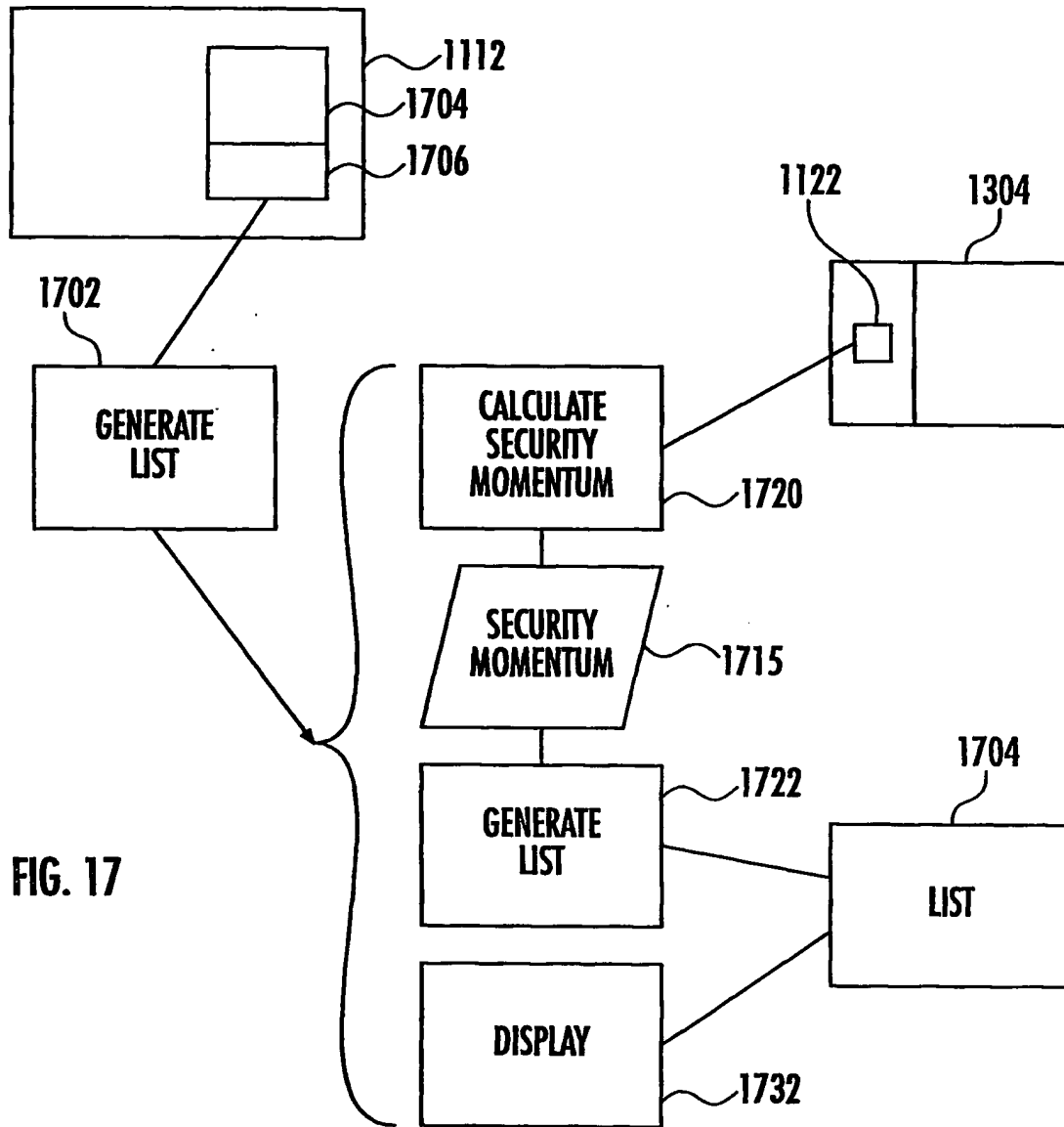LIST

LIST

FIG. 17

DISPLAY

1732

1704

```
struct DataRepresentingTick
    {
        char      Symbol[4]; // identify security
        time_t  TickTimes[12]; // stores the tick times for the security identified by
                                // symbol
    }
```

1740

1306

FIG. 17A